



Proliferation of Precision Strike: Issues for Congress

Randy Huiss
USAF Fellow

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Summary

Iron emerged in the eighth century B.C., helping to usher in the use of cavalry instead of chariots. Today's new technologies, including the development of precision-guided weaponry, have given rise to new methods of war fighting, thus bringing dramatic change to the operational battlefield. As will other decision makers, Members of Congress will confront significant challenges in making their choices about how to adapt to the continually evolving environment, particularly with respect to what are called "precision strike" capabilities.

The United States took the early lead in the development of precision strike and has enjoyed a monopoly on these systems for over 20 years. However, many experts agree that the U.S. advantage is eroding as these systems spread. A demonstration of this proliferation occurred in 2006, when Hezbollah successfully used a Chinese-designed C-802 Anti-Ship Cruise Missile (ASCM) against an Israeli corvette off the coast of Lebanon. This event demonstrated a non-state terrorist organization's successful use of precision strike technology. In addition, access to the global commons is fundamental to global commerce and security—the proliferation of technology could threaten U.S. unfettered access.

Effective use of precision strike weapons goes beyond that of the weapon itself. The weapon is one part of a much greater, elaborate system of capabilities the actor must either possess or to which it must have access. Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR), in particular, plays a critical role in precision strike.

Many experts believe the proliferation of precision strike has already begun and will continue to accelerate as more and more countries continue to develop and purchase precision strike weaponry. Three such countries include China, Iran, and Russia. China's recent military buildup and its strategy with an apparent focus on anti-access/area denial capabilities entails a number of precision strike weapon systems to include the DF-21D anti-ship ballistic missile, which some defense analysts have labeled a "game changer." Iran, although at a much smaller and less elaborate scale, has also entered the precision-guided munitions regime with an outward belligerence toward closing the economically vital Strait of Hormuz, where 40% of the world's oil passes daily. Russia continues to supply arms to the international community and is focusing on developing its own fifth generation fighter comparable to the U.S. F-22 Raptor. Finally, a Russian defense company is currently marketing a new cruise missile system that can be hidden inside a standard shipping container. The housing of the system blends in with the hundreds of thousands of shipping containers used every day in carrying the world's commerce. Some defense experts have expressed fear that a weapon with such camouflage capability could give any merchant vessel the capability to wipe out an aircraft carrier.

The proliferation of precision strike creates potential issues for Congress. These issues include whether the Department of Defense (DOD) is properly taking adversary precision strike weapons into account in its own plans and programs, and whether Congress should approve, reject, or modify proposed DOD programs for responding to those weapons.

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Introduction

This report provides background information and considers issues for Congress related to the worldwide proliferation of “precision strike” capabilities. Precision strike systems utilize projectiles, bombs, missiles, torpedoes, and other weapons that can actively correct for initial-aiming or subsequent errors by homing on their targets or aim-points after being fired, released, or launched. Some analysts state that “the United States took an early lead in exploiting the promise of precision-strike systems and the use of precision weaponry has given the United States a battlefield edge for twenty years. However, these weapons are now spreading: other countries, and non-state actors, are acquiring them and developing countermeasures against them.”¹ As precision-strike capabilities spread, will the United States see its edge erode? The fact that this ability of the United States to project power could also diminish possibly leaving U.S. forces, and eventually the United States itself, increasingly vulnerable to precision weapons in the hands of its adversaries will raise a number of serious considerations for Members of Congress.

Such proliferation could lead to events such as the following:

- U.S. ground forces having to fight without the inherent safety of air superiority/supremacy, leaving them vulnerable to attack by enemy air forces for the first time in nearly 70 years.²
- U.S. naval forces being restricted from protecting the world’s waterways by anti-access/area denial measures, such as those under development in China, which could directly affect the U.S. ability to support key allies and greatly affect international trade and commerce.
- Use of Guided Rockets, Artillery, Mortars and other Missiles (G-RAMM) against a U.S. expeditionary force’s Forward Operating Bases (FOBs).

The proliferation of precision strike creates potential issues for Congress. Oversight issues include whether the Department of Defense (DOD) is properly taking adversary precision strike weapons into account in its own plans and programs. Authorization and appropriations issues include whether Congress should approve, reject, or modify proposed DOD programs for responding to those weapons. Congress’s decisions regarding combating the proliferation of precision strike in its oversight role could be wide-ranging, substantially affecting a variety of key factors, including

- capabilities and funding requirements;
- service force levels and missions;
- technology proliferation strategy;
- forward-deployed basing considerations;
- level of support given to allies;

¹ Thomas G. Mahnken, “Weapons: The Growth & Spread of the Precision Strike Regime,” *Daedalus, the Journal of the American Academy of Arts & Sciences*, June 1, 2011.

² “American troops have not had to fight without air superiority since 1942,” Col. Phillip S. Meilinger, USAF, “Ten Propositions: Emerging Airpower,” *Airpower Journal*, Spring 1996, p. 2.

- strength of U.S. influence around the globe; and
- the defense industrial base.

Finally, should Congress legislate requirements for DOD to develop precision strike countermeasures and then provide funding for that research and development?

Background

Definitions

Precision Strike—Precision strike is the striking of an adversary while utilizing guided munitions.

Long-Range Strike—“The capability to achieve a desired effect(s) rapidly and/or persistently, on any target, in any environment, anywhere, at any time.”³ For example, bomber aircraft such as the B-52, B-1, and B-2 are long-range strike aircraft capable of taking off from the continental U.S. (CONUS) and striking targets anywhere in the world.

Precision Guided Munition (PGM)—A weapon that uses a seeker to detect electromagnetic energy reflected from a target or reference point and, through processing, provides guidance commands to a control system that guides the weapon to the target. For definition sake, the “term guided munitions will hereafter refer to projectiles, bombs, missiles, torpedoes and other weapons that can actively correct for initial-aiming or subsequent errors by homing on their targets or aim-points after being fired, released or launched. Prominent examples of guided munitions in U.S. combat experience during the past six decades include naval surface-to-air missiles (SAMs) such as the American Talos, the Soviet built SA-2 SAM, laser guided bombs (LGBs), the Sidewinder and Sparrow III air-intercept missiles (AIMs), the Tomahawk Land Attack Missile (TLAM), the Conventional Air Launched Cruise Missile (CALCM) and the Joint Direct Attack Munition (JDAM).”⁴

Smart Bomb—A steerable, radio-controlled, laser- or satellite-guided bomb designed to precisely hit a target and minimize collateral damage. A member of the PGM family.

Dumb Bomb—“A bomb that is neither powered nor guided and depends on accurate dropping on the target for its effectiveness.”⁵

Air Superiority—“That degree of dominance in the air battle of one force over another that permits the conduct of operations by the former and its related land, maritime, and air forces at a given time and place without prohibitive interference by the opposing force.”⁶

³ Ravi Chona, “Aerospace Structures for the Century: An Air Force Perspective on Research Needs,” Senior Scientist and Director, Structural Sciences Center, Air Vehicle Directorate, SDM Keynote Lecture, 46th AIAA/ASME/ASCE/AHS/ASC SDM Conference, Austin, TX, April 18, 2005.

⁴ Barry D. Watts, “Six Decades of Guided Munitions and Battle Networks: Progress and Prospects,” Center for Strategic and Budgetary Assessments (CSBA) Report, March 2007, p. 1.

⁵ <http://www.encyclopedia.com> referenced October 4, 2011.

⁶ Department of Defense, Joint Pub 3-30, Command and Control of Joint Air Operations, p. GL-6.

Air Supremacy—“That degree of air superiority wherein the opposing air force is incapable of effective interference.”⁷

Anti-Access—“any action by an opponent that has the effect of slowing the deployment of friendly forces into theater, preventing them from operating from certain locations within that theater, or causing them to operate from distances farther from the locus of conflict than they would normally prefer.”⁸

Area Denial—“activities that seek to deny freedom of action within areas under the enemy’s control.”⁹

Brief History of Precision Strike

Guided weapons, including the V-1 cruise missile and V-2 ballistic missile, but also the Fritz X air-to-surface weapon, were first used in combat by Germany during World War II. However, the United States took the lead in developing the precision weapons in the decades that followed.¹⁰

Indeed, many of the weapon systems associated with the information revolution—precision-guided munitions (PGMs), unmanned air vehicles (UAVs) and sensors—date back to the 1960s and 1970s, and many saw their debut in the Vietnam War.¹¹

Between 1968 and 1973, for example, the Air Force and Navy expended more than 28,000 laser guided bombs (LGBs) in Southeast Asia, mainly against bridges and transportation chokepoints.¹²

These quotes highlight the fact that precision weapons are not a new idea, even though they have gained prominence in relatively recent years. In 2007, Center for Strategic and Budgetary Assessments (CSBA) analyst Barry Watts released a report detailing the history of precision-guided weapons starting at the end of World War II (WWII) covering the past six decades.¹³ He notes, “The fact that early trials of weapons conceptually recognizable as guided munitions occurred so many decades ago suggest how long, uneven, and troubled an emergence many of these weapons have had, notwithstanding some early successes in actual combat.”¹⁴ Only

⁷ Department of Defense, Joint Pub 3-30, Command and Control of Joint Air Operations, p. GL-7.

⁸ Roger Cliff, Mark Burles, Michael S. Chase, Derek Eaton and Kevin L. Pollpeter, “Entering the Dragon’s Lair: Chinese Anti-Access Strategies and Their Implications for the United States,” Rand Corporation, 2007.

⁹ Maj Christopher J. McCarthy, “Anti-Access/Area Denial: The Evolution of Modern Warfare,” U.S. Naval War College Paper.

¹⁰ Ibid.

¹¹ Thomas G. Mahnken, “Weapons: The Growth & Spread of the Precision-Strike Regime,” *Daedalus, the Journal of the American Academy of Arts & Sciences*, June 1, 2011.

¹² Thomas G. Mahnken, “Technology and the American Way of War since 1945,” *New York: Columbia University Press*, 2008.

¹³ For more in depth reading on the history of precision weapons, see Barry D. Watts, “Six Decades of Guided Munitions and Battle Networks: Progress and Prospects,” *Washington, D.C.: Center for Strategic and Budgetary Assessment*, March 2007.

¹⁴ Ibid.

recently, starting with the successful use by the United States during Operation Desert Storm, has the world seen the kind of impact precision guided weapons can have.

The military services have accepted the development and employment of precision-guided weapons at both different rates and to different degrees. For example,

the U.S. Navy began employing guided torpedoes during World War II and, during the Cold War that followed, the only unguided torpedo the USN's submarine community accepted into operational service had a nuclear warhead. The U.S. Army's tank community, on the other hand, relies to this day primarily on aimed fire from a high-velocity main gun for tank-on-tank engagements. The fundamental reason for the wide variation in when different Services and communities within those Services embraced guided munitions appears to lie in the complexity of engagement dynamics. The more dimensions in which the delivery platform, the target platform, or both, can maneuver, the stronger the tactical imperative to move to guided munitions.¹⁵

In addition, the Navy historically has faced a greater number of asymmetric threats requiring PGM technology in order to counter. Examples include the German U-boats, as well as the Japanese kamikazes, which explains, to a certain extent, the fondness the Navy has shown over the years for PGMs and their associated technology.

Effective PGMs took some time to “arrive.” “For the most part, the conventional guided weapons of the 1940s, 1950s, 1960s and early 1970s were too few, too inaccurate, too unreliable, or too susceptible to simple countermeasures to precipitate anything approaching a revolution of military affairs (RMA) comparable to the rise of armored warfare (Blitzkrieg) or carrier aviation during the interwar years 1918-1939.”¹⁶ It was not until the 1991 Gulf War that PGMs as known today really came into their own.

U.S. Use of Precision Guided Munitions (PGMs)

Desert Storm

The unparalleled accuracy of PGMs has increased the effectiveness of the air campaign exponentially, and “the Gulf War showed how radically precision attack had transformed the traditional notion of running a military campaign and, especially, an air campaign. On opening night of the war, attacks by strike aircraft and cruise missiles against air defense and command and control facilities essentially opened up Iraq for subsequent conventional attackers. Precision attacks against the Iraqi Air Force destroyed it in its hangars, and precipitated an attempted mass exodus of aircraft to Iran. Key precision weapon attacks against bridges served to ‘channelize’ the movement of Iraqi forces and create fatal bottlenecks, and many Iraqis, in frustration, simply abandoned their vehicles and walked away.”¹⁷ The results were striking: “this destruction had taken place in an astonishingly short time; whereas, in previous non-precision interdiction campaigns, it often took hundreds of sorties to destroy a bridge, in the Gulf War precision

¹⁵ Thomas G. Mahnken, “Weapons: The Growth & Spread of the Precision-Strike Regime,” *Daedalus, the Journal of the American Academy of Arts & Sciences*, June 1, 2011.

¹⁶ Ibid.

¹⁷ Richard P. Hallion, “Precision Guided Munitions and the New Era of Warfare,” *Air Power Studies Centre, Royal Australian Air Force*, 1995.

weapons destroyed 41 of 54 key Iraqi bridges, as well as 31 pontoon bridges hastily constructed by the Iraqis in response to the anti-bridge strikes, in approximately four weeks.”¹⁸

The Gulf War also illustrated the improved efficiency and effectiveness precision strike can yield:

the combination of the stealthy F-117 Nighthawk aircraft and PGMs gave U.S. forces extremely high effectiveness. A typical non-stealth strike formation in the Gulf War required thirty-eight aircraft, including electronic warfare and defense suppression aircraft, to allow eight planes to deliver bombs on three targets. By contrast, only twenty F-117s armed with 2,000 lb LGBs were able simultaneously to attack thirty-seven targets in the face of more challenging defenses. As a result, although F-117s flew only 2 percent of the total attack sorties in the war, they struck nearly 40 percent of strategic targets, such as leadership and command and control facilities.¹⁹

Additionally, “on one night alone, 46 F-111F attack aircraft dropped 184 LGBs, which destroyed 132 Iraqi armored vehicles.”²⁰

Kosovo

Operations in Kosovo in 1999 represented a step forward in the use of precision strike. “The 1999 war over Kosovo saw the introduction of a new generation of PGMs guided by data from the Global Positioning System (GPS) satellite constellation, most notably the GBU-31 Joint Direct Attack Munition (JDAM). The weapon consists of a \$20,000 kit, including a GPS receiver, sensors, and tailfins, that converts an unguided bomb into a guided weapon. In contrast with the laser-guided bombs used in Vietnam and the Gulf War, such weapons allow aircraft to strike at night and through inclement weather.”²¹ The B-2 bomber was instrumental in the successful air campaign, as it “delivered 652 2,000-pound (lb) JDAMs and four 4,700-lb Global Positioning System (GPS)-Aided Munitions (GAMs) against Serbian targets during NATO’s 78-day air campaign”²² with an accuracy rate over 90% within 13 meters (42.7 feet).

As precise as the PGMs guided by GPS are, they are still only as good as the coordinates/data placed into their guidance systems. An example of an error in the use of PGMs was the accidental bombing of the Chinese Embassy on May 7, 1999. On this date, a B-2 bomber dropped two JDAMs onto the Chinese Embassy by mistake due to faulty targeting and maps.²³ The bombs accurately struck their targets consistent with their programming; their programming was wrong.

¹⁸ Department of Defense, “Conduct of the Persian Gulf War: Final Report,” *Government Printing Office*, 1992.

¹⁹ Thomas G. Mahnken, “Weapons: The Growth & Spread of the Precision-Strike Regime,” *Daedalus, the Journal of the American Academy of Arts & Sciences*, June 1, 2011.

²⁰ Thomas G. Mahnken, “Technology and the American Way of War since 1945,” *New York: Columbia University Press*, 2008.

²¹ Thomas G. Mahnken, “Weapons: The Growth & Spread of the Precision-Strike Regime,” *Daedalus, the Journal of the American Academy of Arts & Sciences*, June 1, 2011.

²² 509 Bomb Wing, “Operation Allied Force,” PowerPoint presentation, August 1999, slide 22.

²³ Internal CIA inquiries concluded the intelligence officers had intended to target the Yugoslav military supply headquarters, but wrongly identified the building housing the Chinese Embassy. Martin Kettle, “CIA Takes Rap for Embassy Attack,” *The Guardian*, April 9, 2000.

Operations Enduring Freedom/Iraqi Freedom

By the time the United States initiated operations in Iraq and Afghanistan in the early 2000s, the situation with respect to precision strike had changed dramatically.

Between 1991 and 2003, PGMs grew from a niche capability to represent a new standard of warfare. Whereas 8 percent of the munitions employed during the Gulf War were guided, 29 percent of those used over Kosovo eight years later, 60 percent of those used in Afghanistan ten years later, and 68 percent of those used in Iraq twelve years later were guided. In Afghanistan, the JDAM became the weapon of choice for U.S. forces. Between October 2001 and February 2002, U.S. forces dropped 6,600 of the munitions; during just one ten-minute period on October 18, 2001, the Air Force dropped a hundred of the bombs. Two years later in Iraq, U.S. forces dropped more than 6,500 JDAMs in the march on Baghdad.²⁴

PGMs from Unmanned Aerial Vehicles (UAVs)

JDAMs were not the only new technology to be used during the Kosovo war. Modern UAVs, such as the Air Force RQ-1A Predator, were used for the first time for reconnaissance and surveillance. Today, as technology and tactics have evolved, those same UAV platforms armed with such weapons as Hellfire missiles are being used extensively in the war on terror. Hellfire missiles have multi-mission, multi-target precision-strike capability, and can be launched from multiple air, sea, and ground platforms. “In November 2002, an AGM-114A Hellfire air-to-surface missile launched by a Predator destroyed a car carrying six terrorists, including Salim Sinan al-Harethi, Al Qaeda’s chief operative in Yemen and a suspect in the October 2000 bombing of the destroyer USS Cole.”²⁵ More recently in September 2011, armed drones reportedly operated by the CIA successfully unleashed a barrage of Hellfire missiles at a car carrying Anwar al-Awlaki, an American-born Muslim cleric, and other top operatives of Al Qaeda’s branch in Yemen, killing Mr. Awlaki after a two-year manhunt.²⁶

The use of precision strike has influenced warfare to such an extent that military forces now have the capability of accurately targeting specific individuals. There is also the inherent ability to limit collateral damage by picking the right-sized weapon for the respective target. A further example of this capability is provided by a DOD press release related to U.S. operations in Afghanistan:

Coalition forces conducted a precision air strike August 21, 2010, targeting a Taliban subcommander in charge of about 10 fighters and facilitation of foreign fighters from Pakistan to Nangarhar. Afghan and coalition forces tracked the commander as he met with at least 25 insurgents armed with assault rifles and rocket-propelled grenades in Deh Bala district to plan an upcoming attack. The commander and a group of 15 insurgents eventually broke from the group and began walking toward an insurgent camp. After positively identifying the commander and ensuring no women or children were present, coalition forces conducted the precision air strike against the commander ... The security force estimated the

²⁴ Thomas G. Mahnken, “Technology and the American Way of War since 1945,” *New York Columbia University Press*, 2008.

²⁵ Thomas G. Mahnken, “Weapons: The Growth & Spread of the Precision-Strike Regime,” *Daedalus, the Journal of the American Academy of Arts & Sciences*, June 1, 2011.

²⁶ Mark Mazzetti, Eric Schmitt and Robert F. Worth, “Two-Year Manhunt Led to Killing of Awlaki in Yemen,” *New York Times*, September 30, 2011.

strike killed 12 insurgents, possibly including multiple Pakistani fighters from Waziristan as well as Taliban fighters. No civilians were wounded or killed.²⁷

Beginnings of Global PGM Use: Non-State Actors

Hezbollah/Israel — 2006

Previous examples have shown how the United States, a major state actor, has used precision strike technology since World War II. However, these weapons are also becoming more available to non-state actors. In the July 2006 war between Israel and Hezbollah, elements of both conventional and irregular warfare were present. According to a study prepared for DOD,

During the 33-day war Hezbollah not only used unguided surface-to-surface rockets, improvised explosive devices (IEDs), and rocket-propelled grenades (RPGs), it also employed a number of guided weapons against Israeli forces, in particular anti-tank missiles and, in one instance, an anti-ship cruise missile (ASCM). With the assistance of its patrons in Tehran and Damascus, Hezbollah was therefore able to acquire the weapons, C4ISR capabilities, and training necessary to develop an effective, “low-end” reconnaissance-strike complex designed to impose heavy costs on an invading ground force.²⁸

There are also reports that Hezbollah has not only restocked its arsenal of rockets and missiles, but that it has also expanded and improved its capabilities by acquiring systems of greater range and accuracy. Some analysts argue that Hezbollah’s successful use of a Chinese-designed C-802 ASCM against an Israeli corvette off the coast of Lebanon should be viewed as “a warning ... for other advanced naval forces: they cannot afford to overlook force protection and defensive requirements against maritime armed groups or hybrid threats that possess state-like capabilities despite their relative small size or non-state status.”²⁹

Others note that this hybrid tactic used by Hezbollah, which included a large-scale use of laser-guided anti-tank missiles, as well as mines, made it difficult for the Israeli ground troops to maneuver their tanks and armored personnel carriers: “The Israelis were forced to move slowly and carefully. Deprived of their traditional advantage of being able to move fast, the Anti-Access/Area Denial (A2/AD) tactics of Hezbollah, at least in the early stages of the war, was a success.”³⁰ They were able to show how a non-state actor could impose significant costs against a superior military force given sufficient resources and training. Some of these same costs can also be seen with China’s emerging A2/AD network, although it has not been tested in combat, which nevertheless highlights a number of potential vulnerabilities in the United States military’s posture in the western Pacific such as lengthy supply lines, reliance on foreign ports and airbases that could be held vulnerable, and as support for regional allies.

²⁷ U.S. Fed News, “Operations in Afghanistan Result in Insurgents Killed, Captured,” *U.S. Department of Defense’s American Forces Press Service*, August 23, 2010.

²⁸ “The Proliferation of Precision-Guided Weapons and the Future of Naval Irregular Warfare: Assessment and Implications,” *Center for Strategic and Budgetary Assessments (CSBA)*, prepared for the Office of Net Assessments, Office of the Secretary of Defense, September 2010.

²⁹ F.G. Hoffman, “Hybrid Threats: Neither Omnipotent Nor Unbeatable,” *Orbis* (Summer 2010), p. 447.

³⁰ Taylor Dinerman, “America, Israel and the Next Stage of the Revolution in Military Affairs,” *Hudson New York Programs*, <http://hudson-ny.org/2221/america-israel-revolution-military-affairs>, June 23, 2011.

Results of U.S. Superiority/Near Monopoly of Precision Strike

Over time, the United States has come to rely on some key elements in prosecuting its global responsibilities that are facilitated by its dominance in precision strike. The first is unfettered access in protecting the global commons.³¹ An appreciation that extends back as far as Mackinder and Mahan, “the ability to protect and control the maritime commons gives unparalleled influence and underpins global systems of trade and commerce.”³²

A second key advantage stemming from U.S. success with precision strike is air superiority. Precision strike is not the only reason the United States has enjoyed air superiority over the years, but it does play a key role. U.S. ground forces have enjoyed the freedom of not having to fight under enemy attacks from the air for nearly 70 years. The Iraqi Air Force was all but destroyed by PGMs as its planes remained in their shelters. The outcome of Desert Storm may have been different had the U.S. not had air superiority/air supremacy from the beginning of the war. The ground forces could have been left to face a battle hardened Iraqi force that, at the time, was the fourth largest army in the world. U.S. casualties could have been significantly higher and could have extended the overall length of the war.

A final key element of the U.S. monopoly of precision strike ties in with the previous two. It is freedom of movement. Freedom of movement is an essential element to warfare, whether on the ground as the sweeping, famed “left hook” the XVIII Airborne Corps performed during the Gulf war showed, or on the sea as was demonstrated in 1996 when President Clinton ordered two U.S. aircraft carrier battle groups into the waters near Taiwan in response to aggressive actions by the Chinese.

Global Positioning Systems

The Global Positioning System (GPS) is a space-based satellite navigation system that provides location and time information in all weather, anywhere on or near the Earth, where there is an unobstructed line of sight to four or more GPS satellites. It is maintained by the U.S. government and is freely accessible by anyone with a GPS receiver. Some civilian receivers are controlled by the U.S. government via export controls. All GPS receivers capable of functioning above 18kms (11 miles) and speeds in excess of 515 meters per second (1,000 nautical miles per hour)³³ are classified as weapons or munitions capable for which State Department-approved export licenses are required. The restrictions attempt to prevent use of the receiver in a ballistic missile, but the restrictions would not prevent the use in a cruise missile, which travels at much lower altitudes and slower speeds.

³¹ Global commons are geographical areas that are outside the jurisdiction of any nation, and include the oceans outside territorial limits and Antarctica. Global commons do not include contiguous zones and fisheries zones of foreign nations. *U.S. Code of Federal Regulations*, Title 32: National Defense, Part 187 – Environmental Effects Abroad of Major Department of Defense Actions, Section 187.3: Definitions.

³² Bryan Clark and Dan Whiteneck, “Strategic Choices at the Tipping Point,” *United States Naval Institute: Proceedings*, February 2011.

³³ Arms Control Association, “*Missile Technology Control Regime*,” viewed April 11, 2012.

Precision Strike and GPS Equivalent Systems

Effective use of precision strike weapons goes beyond that of the weapon itself. The weapon is one part of an elaborate system or complex. To launch a precision strike, the actor would need to possess the weapon, some sort of guidance system (whether it is a Global Positioning System [GPS] or something different), sensors to locate the target, command and control of the weapon system, effective doctrine on implementation, and, finally, organization to bring all the components together. Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) plays a critical role in precision strike. Being able to develop and successfully implement the entire spectrum of these systems has given the United States the advantage in the precision strike arena. In addition, the U.S. has outspent everyone else for decades.

However, some analysts state that

we should not be surprised by the spread of precision-strike capabilities. Some suggest it was historically inevitable, even if the process has been accelerated by the commercial availability of key supporting capabilities, such as imagery and command and control. Of greatest significance, however, is the universal free access to precision navigation and timing data, such as that from the U.S. GPS satellite constellation. Whereas the development of the precision guidance cost the United States billions of dollars over the course of decades, both state and non-state actors can now strike accurately with minimum investment.³⁴

Cost of U.S. Global Positioning System

One factor contributing to the long-term U.S. dominance in precision strike capabilities may be the cost of building and maintaining GPS: “Rockwell Collins International manufactured the original NAVSTAR satellites that comprise the current United States GPS system. This system was originally developed by the U.S. Department of Defense with an estimated cost of over \$12 billion. The U.S. Navy and the U.S. Air Force combined to form NAVSTAR in 1973, and they launched the first satellite in 1974.

Subsequent launchings, with satellites produced by Boeing and Lockheed Martin, have produced the current constellation of 24 operating satellites that became fully operational on December 8, 1993. The estimated annual cost to operate and maintain the GPS satellite system is \$750 million.”³⁵

Figure I. GPS Satellite in Flight



Source: http://www.thecarconnection.com/image/1001811993_gps-satellite.

³⁴ Thomas G. Mahnken, “Weapons: The Growth & Spread of the Precision-Strike Regime,” *Daedalus, the Journal of the American Academy of Arts & Sciences*, June 1, 2011.

³⁵ Information taken from James Madison University website: <http://cissr.jmu.edu/sic/gps/satellite.htm> on December 2, 2011.

Russian Global Orbiting Navigation System

Russia's Global Orbiting Navigation Satellite System (GLONASS) is a global positioning system like the American and European GPS networks. GLONASS is operated by the Russian Space Forces and uses radio time signals to locate people and vehicles on and above the surface of the Earth.

In 1982, the former USSR matched America's NAVSTARs with a new generation of high-flying navigation satellites when it launched the test satellites Cosmos-1413, Cosmos-1414 and Cosmos-1415 on one rocket to start GLONASS. The first operational satellites went into service in December 1983. Russia continued building the GLONASS system after the old Soviet Union dissolved in the early 1990s. The system was in full operation by December 1995.

A poor economic situation after the fall of the Soviet Union left Russia with only eight GLONASS satellites in operation by 2002. Economic conditions improved and 11 satellites were in operation in 2004. A total of 14 were in orbit at the end of 2005.... Like the U.S. and European GPS networks, the complete GLONASS constellation was, and again in the future is to be, 24 satellites. That would include 21 operating in three circular orbital planes, and three satellites standing by on orbit as backup spares.³⁶

On December 8, 2011, GLONASS regained full operational capability.

³⁶ Information taken from Space Today Online website: <http://www.spacetoday.org/Satellites/GLONASS.html> on December 1, 2011.

Figure 2. Russia's GLONASS Satellite Navigation System (2007)



Source: Rian, at http://www.en15.rian.ru/img/94214238_free.html.

Today, GLONASS is still primarily a Russian military system but is being pushed more and more into the civilian marketplace by the Russian government. "Russian Federation Presidential Decree from 17 May 2007 granted the international community unrestricted access to GLONASS navigation services free of charge."³⁷ As such, GLONASS will continue to be pushed as a dual use (military and civilian) global navigation system.

³⁷ Information taken from Navigation-Information-Systems GLONASS (NIS GLONASS) website at http://www.nis-ghonass.ru/en/ghonass/technical_descript/ on January 6, 2012.

Chinese Regional System

On December 27, 2011, China started its own regional global positioning system. A regional system, as the name implies, focuses on a specific area or region of the globe. This differs from a global system, which requires many more satellites for worldwide capability. The Chinese regional system, called Beidou, or Big Dipper, is composed of “10 orbiting satellites, covers an area from Australia in the south to Russia in the north. Signals can reach the Xinjiang Uygur autonomous region in the west and the Pacific Ocean in the east. With six more satellites to be launched next year, the system will cover a wider area and eventually the entire globe by 2020 with a constellation of 35 satellites.”³⁸ This new global positioning system capability will enable China to control its own precision strike weapons without reliance on any other country’s system such as the U.S. GPS or Russian GLONASS.

An independent global navigation system could give China a considerable strategic military advantage in the event hostilities should break out in the Asia Pacific Region.

Most notably, such an advantage would be useful in countering foreign naval forces and with particularity those of the United States. Of late, China has been posturing its desire to obtain the ability to eliminate United States’ aircraft carriers through the use of its DF-21D ballistic missile. With an active GPS such as Beidou in place, China could theoretically use that capability in combination with drones to accurately guide these anti-ship missiles to their targets. Such an advantage could prove useful in deterring or hindering the ability of the United States or even India to project air power to intervene with any military operation China decides to take against Taiwan, the Philippines or any other interests China has in the South China Sea.³⁹

Some analysts say China is accelerating its military space program to target U.S. aircraft carriers. The surge in development and launch activities has also caught the attention of the U.S. Secretary of Defense and has begun to affect DOD planning. Little U.S. or political and media attention has focused on this trend, which some are calling a new space race with only one participant.

During 2010, China launched 12 military satellites, more than doubling its previous rates of three to five launches each year between 2006 and 2009. Since 2006, China has launched about 30 military related spacecraft. Its total of 15 launches in 2010 set a new record for China and for the first time equaled the U.S. flight rate for a given year.

At least three or four different Chinese military satellite systems are being networked to support China’s 1,500 km plus range DF-21D Anti-Ship Ballistic Missile (ASBM) program, say U.S. analysts. The DF-21D is being designed to force U.S. Navy aircraft carrier battle groups and other large U.S. allied warships to operate hundreds of miles farther away from China or North Korea than they do today.

Yaogan spacecraft form the core of Chinese military space operations. But this designation is a cover to maintain secrecy for at least four different military designs, including satellites with electro-optical digital imaging cameras, a totally different spacecraft with synthetic aperture radar imaging, a third type with signal intercept and a fourth with electronic

³⁸ Xin Dingding, “Chinese Satellite Navigation System Beidou Begins Test Services,” *China Daily* Beijing, December 30, 2011.

³⁹ Michael Listner, “China’s Beidou Global Navigation System,” *Defensepolicy.org*, August 3, 2011.

eavesdropping capability. A fifth version is for formation flight and has ocean surveillance sensors. Thirteen Yaogan satellites launched since 2006 are engaged in military space activity and most remain operational.⁴⁰

In written testimony to the Senate Armed Services Committee on February 16, 2012, Defense Intelligence Agency Director Lt. Gen Ronald Burgass Jr. stated that China operates many satellites for research, weather monitoring, communications, and reconnaissance purposes. He continued that it is tough to know exactly what China is getting out of these spacecraft, as Beijing rarely acknowledges direct military applications of its space program and refers to nearly all satellite launches as scientific or civil in nature.⁴¹

Andrew S. Erickson, a Naval War College expert on China's naval and space forces, has written a number of articles on China's emerging space capabilities. He opines that China appears to have very advanced capabilities in both electro-optical and radar imaging, with very high resolution. These are capabilities that could be used to further develop space-based information, surveillance, and reconnaissance to support precision strike.

Some see Chinese space launches as essential to an increased ASBM capability. Ian Easton, for example, a research fellow at the Project 2049 Institute,⁴² based in Arlington, VA, recently wrote in the "Asia Eye" blog, that "unlike previous electro-optical and radar imagery satellites deployed in the series, the Yaogan 9 launch positioned three satellites (A/B/C) orbiting in a highly choreographed triangular formation, suggesting that China had deployed a dedicated Naval Ocean Surveillance Satellite system to bolster the ASBM program. Space-based surveillance and cueing capabilities represent an essential (and previously underdeveloped) element of the ASBM program." Some experts believe the September 2010 launch of the Yaogan-11A/B/C are radar imagery satellites with all weather, day/night capability and could be used to help track carrier strike groups.

Current/Developing Precision Strike Threats

Many experts believe the proliferation of precision strike has already begun and will continue to accelerate as more and more countries continue to develop and purchase precision strike weaponry. The chart below was developed by James Howe in association with the Office of the Secretary of Defense Net Assessment Summer Study in 2010 titled "The Growth and Spread of the Precision Strike Regime." The chart displays a snapshot of estimated worldwide precision strike capabilities between 2020 and 2040.

According to the study, "this map offers a first-order estimate of the geography of the mature precision-strike regime. It shows that the growth and spread of the precision strike regime is likely to be quite uneven.

⁴⁰ Craig Covault, "China's Military Space Surge," *Aerospace America*, March 2011.

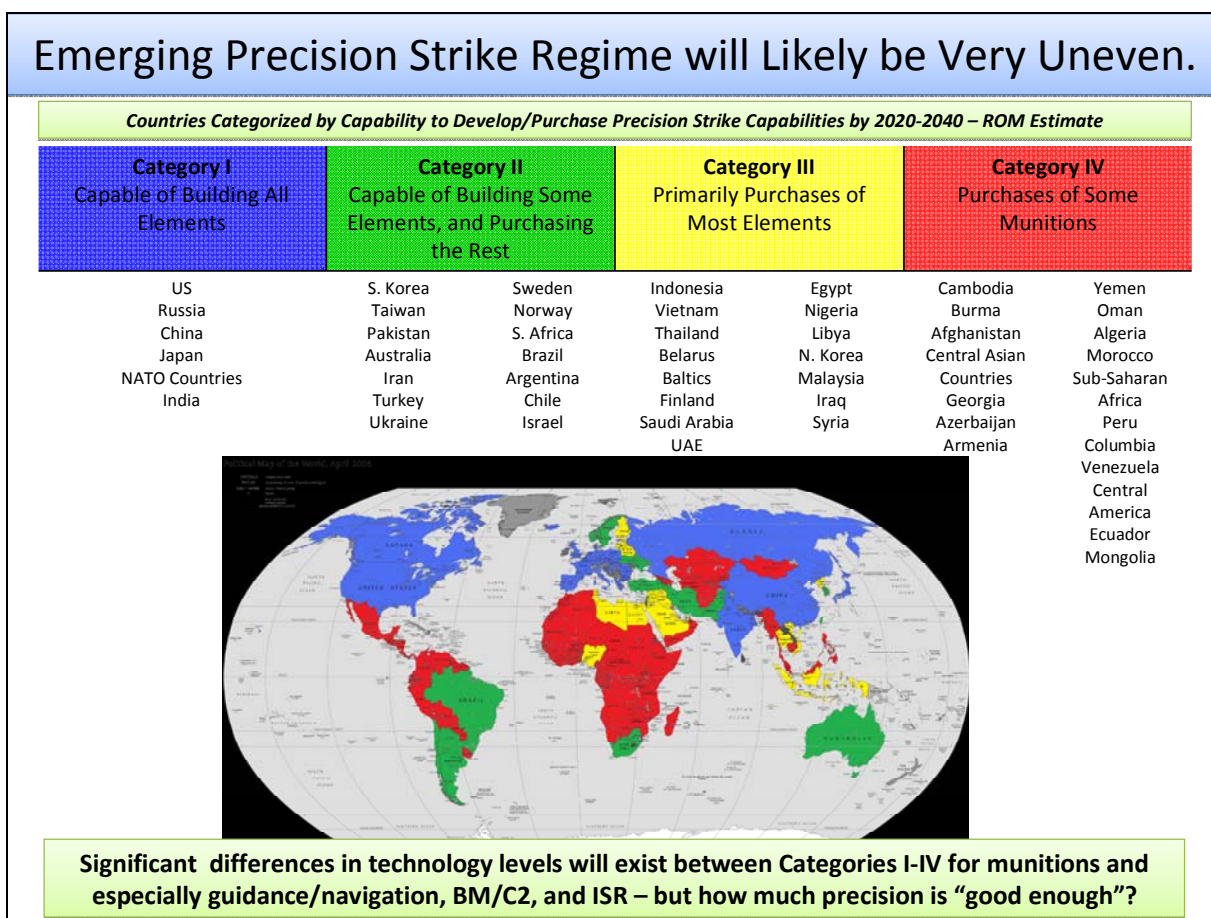
⁴¹ Written testimony to the Senate Armed Services Committee by Lt. Gen Ronald Burgass Jr., Director of the Defense Intelligence Agency, February 16, 2012, during a hearing on the current and future worldwide threats to the national security of the United States.

⁴² Project 2049 Institute is a think tank dedicated to studying Chinese national security issues.

- Category I countries are those that are capable of fielding all elements of a precision strike system.
- Category II countries are those that are capable of fielding some elements of a precision strike system and purchase the rest.
- Category III countries are those that will be forced to purchase most elements of a precision strike system.
- Category IV countries are those that will have commercial access to some precision strike munitions, particularly short range systems.⁴³

Figure 3. Emerging Precision Strike Regime

2020-2040 Estimate



Source: OSD Net Assessment Summer Study 2010.

In addition, some countries are developing capabilities aimed at countering U.S. precision strike dominance. The following is a sampling of a few countries actively developing and/or purchasing precision strike weapons and/or countermeasures. These three countries are a sampling and by no means a comprehensive worldwide overview.

⁴³ “The Growth and Spread of the Precision Strike Regime,” OSD Net Assessment Summer Study, July 26-August 4, 2010, Naval War College, Newport, RI.

China

Some analysts believe an increasing effectiveness and reach of both piracy and the proliferation of long-range and sophisticated anti-ship weapons could alter today's unrestricted access to the global commons. China's Anti-Access/Area Denial (A2/AD) strategy in particular may highlight some of the potential challenges of the future.

Many defense experts argue that China's A2/AD build-up is designed to disrupt potential U.S. power projection in the western Pacific, as well as project power within and beyond the South China Sea: "The PLA's aggressive posture in the South China Sea and its increasing military edge over Taiwan are sources of concern—as are its investments in nuclear submarines, which suggest China is seeking to support operations well beyond Taiwan."⁴⁴ Chinese use of PGM technology may allow China to effectively block U.S. forces from strategic areas such as the South China Sea and the defense of Taiwan.⁴⁵

Precision strike capabilities are central to Chinese military modernization, especially in development of its anti-access doctrine. According to CRS Naval Specialist Ron O'Rourke,

DOD and other observers believe that the near-term focus of China's military modernization effort, including its naval modernization effort, has been to develop military options for addressing the situation with Taiwan. Consistent with this goal, observers believe that China wants its military to be capable of acting as a so-called anti-access force—a force that can deter U.S. intervention in a conflict involving Taiwan, or failing that, delay the arrival or reduce the effectiveness of intervening U.S. naval and air forces. Anti-Ship Ballistic Missiles (ASBMs), attack submarines, and supporting C4ISR systems are viewed as key elements of China's emerging anti-access force, though other force elements—such as Anti-Ship Cruise Missiles (ASCMs), Land Attack Cruise Missiles (LACMs) (for attacking U.S. air bases and other facilities in the Western Pacific), and mines—are also of significance.⁴⁶

The elements of China's new strategy (with the exception of mines) are heavily composed of precision guided weapons (ASBMs, ASCMs, LACMs, torpedoes). As mentioned previously, the developing Beidou satellite positioning system will eventually help serve as the guidance enabler for these PGMs.

Some analysts state that precision strike is part of China's asymmetric response to U.S. air and naval superiority. One argues, for example, that "when the cold war ended, the Pacific Ocean became, in effect, an American lake. With its air and naval forces operating through bases in friendly countries like Japan and South Korea, the United States could defend and reassure its allies, deter potential aggressors and insure safe passage for commercial shipping throughout the Western Pacific and into the Indian Ocean. Its forces could operate everywhere with impunity."⁴⁷ China has shown, and many in the defense department agree, that Beijing is not trying to match American power plane for plane or ship for ship. Rather, it is using this A2/AD strategy to prepare asymmetrically for any future potential clash with the United States.

⁴⁴ Phil Stewart, "China's Military Buildup: How Far Along Is It?", *Reuters*, October 11, 2011.

⁴⁵ For more information please see CRS Report RL33153, *China Naval Modernization: Implications for U.S. Navy Capabilities—Background and Issues for Congress*, by Ronald O'Rourke.

⁴⁶ Ibid.

⁴⁷ Aaron L. Friedberg, "China's Challenge at Sea," *New York Times*, September 5, 2011.

DF-21D

In September 2010, then U.S. Secretary of Defense Robert Gates warned of anti-access and precision strike threats to the United States during an Air Force Association Convention. “When considering the military-modernization programs of countries like China, we should be concerned less with their potential ability to challenge the U.S. symmetrically—fighter to fighter or ship to ship—and more with their ability to disrupt our freedom of movement and narrow our strategic options,” he said.⁴⁸ Gates went on to say that China’s investment in cyber and anti-satellite warfare, anti-air and anti-ship weaponry, and ballistic missiles could also threaten America’s primary power projection instruments of forward air bases and carrier strike groups. Some analysts believe the DF-21D is exactly this type of weapon.

⁴⁸ Weapon and Technology, “DF-21D – Chinese Aircraft Carrier-Killing Missile,” accessed at <http://weapons.technology.youngster.com/2010/08/df-21d-chinese-aircraft-carrier-killing.html> on August 23, 2011.

Figure 4. Chinese DF-21D

Example Attack



Source: Pakistan Defence website at <http://www.defence.pk/forums/china-defence/86471-china-missile-shifts-power-pacific-3.html>.

The Chinese-designated DF-21 (East Wind-21) intermediate-range ballistic missile has the NATO designation CSS-5, and is a variant of the CSS-N-3 (JL-1) submarine-launched ballistic missile developed from the mid-1960s and first test launched in 1982. The road mobile DF-21 was first successfully test flown in 1985, and the missile is a replacement tactical nuclear missile for the liquid-fueled DF-2 (CSS-1). Continued program upgrades and versions appeared in the decades that followed, leading to the present version known as the DF-21D. Some analysts have stated it could be a game changer. The DF-21D version is believed to be for use against ship targets, with a maximum range of 1,450 to 1,550 km. The Re-entry Vehicle (RV) reportedly is maneuverable, which suggests that it could also fly at a low altitude (below 100 m). The target ship location would presumably be supplied by other sensors such as submarines, Unmanned Aerial Vehicles (UAVs), satellites, or even fishing boats, and then the target would be located by the terminal phase sensor in the RV as it approaches the selected ship. It is assumed that the Circular Error

Probability (CEP)⁴⁹ would be below 20 m, but no figure has been reported.⁵⁰ Late maneuverability at such high speeds gives the DF-21D a very dangerous precision strike capability.

A 2010 CRS report captured observers' concerns about the DF-21D. Such missiles, it argued, "in combination with broad-area maritime surveillance and targeting systems, would permit China to attack aircraft carriers, other U.S. Navy ships, or ships of allied or partner navies operating in the Western Pacific. The U.S. Navy has not previously faced a threat from highly accurate ballistic missiles capable of hitting moving ships at sea. Due to their ability to change course, the maneuverable re-entry vehicles on the anti-ship ballistic missile would be more difficult to intercept than non-maneuvering ballistic missile re-entry vehicles."⁵¹ The DF-21D's

1,500+ km range could result in a large and strategically important denial area that stretches into the Western Pacific, going well beyond Taiwan and the first island chain, which "stretches from the southern tip of Japan, south past Taiwan on the west and the Philippines and Malaysia on the east, curving around the South China Sea. The second island chain stretches from the middle of Japan far out in to the western Pacific curving southward to Guam and then to Indonesia."⁵²

Some analysts worry that

the DF-21D ... could be the definitive threat to the surface warship, which has so far survived a century-long struggle against submarines, aircraft and more recently, cruise missiles. In the view of some analysts, surface warships—above all, aircraft carriers—are fundamentally too vulnerable to such a weapon, because their signatures are so large, while the missile is so hard to intercept.

Skeptics respond that the DF-21D's kill chain can be broken in several places—for example, in target detection and tracking before launch or in the final homing descent. Still given the stakes, it seems that a navy facing DF-21Ds would have to be confident of breaking that kill chain every time.⁵³

In addition, "it should be noted that the concept of using ballistic missiles to attack ships at sea has been raised on a number of occasions ... unfortunately for the proponents of such systems, the

Figure 5. Chinese DF-21D



Source: Generational Dynamics at <http://www.generationaldynamics.com/cgi-bin/D.PL?d=ww2010.weblog>.

⁴⁹ Circular Error Probability is an indicator of the delivery accuracy of a weapon system, used as a factor in determining probable damage to a target. It is the radius of a circle within which half of a missile's projectiles are expected to fall. Also called CEP.

⁵⁰ DF-21 information taken from "Janes' Strategic Weapons Systems: DF-21 (CSS-5)" posted June 21, 2011.

⁵¹ CRS Report RL33153, *China Naval Modernization: Implications for U.S. Navy Capabilities—Background and Issues for Congress*, by Ronald O'Rourke.

⁵² Elinor Sloan, "U.S. – China Military and Security Developments," *International Journal*, Spring 2011.

⁵³ Bradley Perrett, "China: DF-21D Anti-Ship Missile Still in Development," *Aerospace Daily & Defense Report*, July 13, 2011.

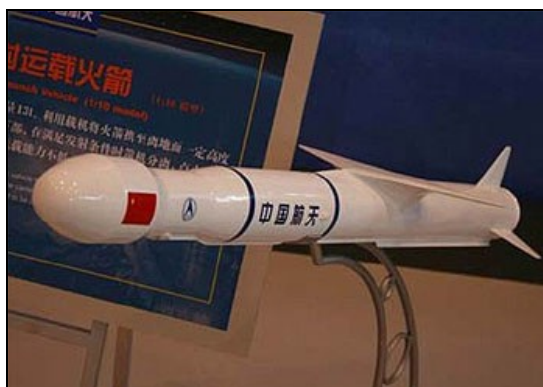
command loops involved and the difficulty in maintaining real-time targeting data with sufficient accuracy to make the concept viable have always conspired to defeat the successful implementation of the idea. There is no indication that the People's Republic of China has overcome these basic problems and, until more detailed data are forthcoming, these reports must be treated with reserve.”⁵⁴

Anti-Satellite (ASAT) Weapons

In addition to precision strike capabilities, China has also demonstrated an important countermeasure to U.S. precision strike in its anti-satellite weapons development. The first successful satellite intercept was made by China in January 2007 from the Xichang satellite launch center,⁵⁵ demonstrating to the world its ability to take down elements of systems such as the U.S. Global Positioning System (GPS) or satellite communications networks without warning. The 2007 intercept was a kinetic weapon; however, high energy-directed weapons can also pose a threat to satellites: “Given China’s current level of interest in laser technology, Beijing probably could develop a weapon that could destroy satellites in the future. Although specific Chinese programs for laser ASAT have not been identified, press articles indicate an interest in developing this capability and Beijing may be working on appropriate technologies.”⁵⁶

U.S. military space capabilities remain critically important to the effectiveness of its precision strike weapons and systems. According to analysts, “Access to space—which has long been ‘militarized’ much to the advantage of the United States—is no longer a sure thing. And even where access might be retained, military dominance and supremacy are uncertain. This is a critical vulnerability for U.S. forces, whose weapons, operations, communications and more depend on it.... Intelligence satellites are essential in even the smallest, most irregular operations against the tiniest terrorist groups, but the loss of larger networks in a conflict against a more sophisticated foe—and China is at the forefront in developing and recently testing anti-satellite systems—would be catastrophic.”⁵⁷

Figure 6. Chinese Anti-Satellite (ASAT) Missile



Source: Spy Flight at <http://www.spyflight.co.uk/china%20asat.htm>.

According to the Director of the Defense Intelligence Agency,

The space program, including ostensible civil projects, supports China’s growing ability to deny or degrade the space assets of potential adversaries. China operates satellites for

⁵⁴ “International Military Markets – Asia, Australia & Pacific Rim,” *Forecast International*, December 2011.

⁵⁵ ASAT information taken from “Janes’ Strategic Weapons Systems: ASAT” posted December 2, 2010.

⁵⁶ “Chinese Anti-Satellite (ASAT) Capabilities and ABM Capability,” Referenced on *Globalsecurity.org* on January 10, 2012.

⁵⁷ Written testimony to the House Armed Services Committee by Thomas Donnelly, Director of Center for Defense Studies, American Enterprise Institute, September 13, 2011.

communications, navigation, earth resources and intelligence, surveillance and reconnaissance. It has successfully tested a direct ascent ASAT and is developing jammers and kinetic and directed-energy weapons for ASAT missions. Technologies from its manned and lunar space programs enhance China's ability to track and identify satellites, a prerequisite for ASAT attacks. Beijing is also increasing the quantity and quality of its satellite constellations, enabling space-based intelligence, surveillance, and reconnaissance, in addition to navigation and communication services. Some Chinese military commentary heavily promotes the importance of controlling space, noting the role of space in long-distance targeting and other battlefield domains. Beijing, however, rarely acknowledges direct military applications of its space program and refers to nearly all satellite launches as scientific or civil in nature.⁵⁸

Some analysts believe that ASAT weapons pose a substantial risk to both civilian and military systems: "Commercial man-made satellites, for instance, offer little, if any, protection against the growing threat of anti-satellite systems, whether ground-based lasers or direct-ascent kinetic-kill vehicles. The Internet was similarly constructed with a benign environment in mind, and the progression toward potential sources of single-point system failure, in the forms of both common software and data repositories like the 'cloud,' cannot be discounted."⁵⁹ In this manner, ASAT weapons could be thought of as counter precision strike in their ability to take down satellites either by kinetic action or jamming of the guidance networks associated with precision strike weapons.

J-20 Stealth Fighter

When they say they are going to build 300 J-20s in the next five years, they will build 300 J-20s in the next five years.—Vice Chairman of the U.S. Air Force, General Breedlove, testifying before the House Armed Services Subcommittee on Readiness—July 26, 2011

Another part of China's ability to deliver precision strike weapons depends on its ability to develop an effective stealth fighter aircraft. Reports note that "China conducted its first flight test of the Chengdu J-20 Black Eagle Stealth Fighter during an official visit to Beijing by U.S. Secretary of Defense Robert Gates in January 2011. The J-20 is China's first stealth fighter jet. This flight test surprised many experts as it signaled that China was making faster-than-expected progress in developing advanced generation fighter jet technology. While the J-20 remains in the testing phase, an effective stealth fighter could enhance China's capability to implement an anti-access/area denial strategy to restrict U.S. military access to the region."⁶⁰ This capability would enable China to deliver precision strike weapons close to a wide range of U.S. targets, even in a robust anti-aircraft environment.

⁵⁸ Written testimony to the Senate Armed Services Committee by Ronald Burgess, Director of the Defense Intelligence Agency, *The Current and Future Worldwide Threats to the National Security of the United States*, March 10, 2011.

⁵⁹ Andrew Krepinevich, "Get Ready for the Democratization of Destruction: The Way the World's Militaries Wage War is Going to Change—Drastically," *Foreign Policy*, September 2011.

⁶⁰ Randy Forbes, "Vice Chair of Air Force, General Breedlove Voiced Concerns Over China's Military Modernization," *China Caucus Blog*, July 28, 2011.

The J-20 aircraft appears to share Russian technology.⁶¹ “Experts say the fifth-generation J-20 fighter ... could have its origins in the Mikoyan 1.44 stealth jet that never made it to the production line.... Similarities between the new Chinese fighter jet and a prototype Russian plane have brought suggestions that Moscow may be quietly helping Beijing compete with the world’s military powers.... Only the United States has an operational fifth-generation fighter, which is nearly impossible to track on radar. Russia is working to start serial production of its prototype craft in the next five to six years.”⁶²

Some observers believe that the appearance of the J-20 shows significant investment by the Chinese in stealth technology, as well as a very formidable platform to employ precision strike weapons. It is also believed that the fighter is not expected to be operational at a “significant level until 2018, as China grapples with production hurdles, in particular engine technology.”⁶³ In the Department of Defense’s (DOD’s) latest annual public threat assessment of China’s military and security developments, DOD analysts appear to have concluded that the Chengdu J-20 fighter is optimized for air-to-ground missions. “Systems such as the J-20 stealth fighter and longer-range conventional ballistic missiles could improve the PLA’s ability to strike regional air bases, logistical facilities and other ground-based infrastructure,” the report says, adding that “the J-20 will eventually give the PLA Air Force a platform capable of long-range, penetrating strikes into complex air defense environments.”⁶⁴

These evolving PLAAF precision-strike capabilities add another layer of anti-access competencies to deter, disrupt, or deny regional bases, as well as naval surface and carrier operations. These include upgraded or new fifth generation aircraft, such as the J-20, that can employ modern precision ordnance, including anti-radiation missiles, air-launched land attack and anti-ship cruise missiles, and a variety of other munitions using laser and Global Positioning System/Global Navigation Satellite System guidance. These last can include “bunker buster” munitions that can be employed in long-range attacks on hardened targets such as aircraft shelters and command and control bunkers at regional bases beyond

Figure 7. Chinese J-20 Stealth Fighter
5th Generation Fighter Aircraft



Source: Flight Global at <http://www.flightglobal.com/blogs/asian-skies/2011/01/j-20-blues-no-first-flight-tod.html>.

⁶¹ Russia and China have long been military (and other goods) trading partners. The People’s Liberation Army (PLA) is working on new classes of missiles, setting up new missile units and upgrading existing weapons. That includes highly accurate land- and sea-based cruise missiles. Several of these designs were acquired from Russia. Russia continues to be a major supplier to China; however, the pervasive Chinese habit of back-engineering imported equipment has led to numerous breaches between Russia and China over intellectual property rights issues.

⁶² Thomas Grove, “New Chinese Stealth Jet Starts Talk of Russian Help,” *Reuters*, August 18, 2011.

⁶³ David A. Fulghum, Bill Sweetman, Bradley Perrett and Robert Wall, “Expanded Reach: China’s Power Projection and Space Activities Are Steadily Increasing,” *Aviation Week & Space Technology*, September 5, 2011.

⁶⁴ *Ibid.*

China's periphery.⁶⁵ These bases could include Kadena Air Base in Okinawa, Yokota Air Base outside of Tokyo, Japan, and Guam Air Base, potentially making staging, logistical supply/resupply, and force employment difficult.

Proliferation to Libya

As major state actors such as China continue to modernize and build their defensive arsenals, they also have the potential to provide these new, modern weapons and technologies to smaller, non-state actors. As an example, during what began as part of the Arab Spring uprising and ended ultimately in the death of embattled Libyan leader Moammar Gadhafi, Chinese arms brokers held negotiations with the Libyan government about sales of precision strike weapons:

China's Foreign Ministry acknowledged ... that state-run arms companies had met Libyan officials this summer to broker arms sales to Col. Moammar Gadhafi's besieged regime, apparently confirming information in Libyan government documents found by a Canadian journalist in Tripoli.... Officials of Libya's transitional government had expressed outrage over the documents, which were first reported by The Globe and Mail of Toronto. The records indicate that, during the meeting in Beijing in mid-July, Chinese arms merchants sought to sell Gadhafi representatives \$200 million worth of sophisticated weapons, including portable surface-to-air missiles⁶⁶ similar to the American made Stinger that potentially could bring down certain military aircraft. Chinese arms brokers suggested that the weapons be delivered via South Africa or Algeria, and said that Algeria's existing stock of Chinese arms could be immediately transferred to Libya and replenished by fresh shipments from China.⁶⁷

Why this "attempted" sale garnered so much attention was due to the passing of United Nations Security Council Resolution (UNSCR) 1970, Libya Sanctions, which banned military assistance to the Gadhafi government. Ultimately there was no evidence that the sale was completed, and Chinese officials remain insistent that no weapons or funds changed hands.

In volatile situations such as Libya, the spread of precision weapons can take very uncertain forms. As the Libyan rebels were making progress against pro-Gadhafi forces, reports surfaced in the media that numerous surface-to-air missiles went missing. The *Christian Science Monitor*

⁶⁵ Michael P. Flaherty, "Red Wings Ascendant: The Chinese Air Force Contribution to Anti-Access," *Joint Forces Quarterly*, issue 60, 1st Quarter 2011.

⁶⁶ From U.S. Department of State website: "Man-Portable Air Defense Systems (MANPADS) are surface-to-air missiles that can be carried and fired by a single individual or carried by several individuals and fired by more than one person acting as a crew. Most MANPADS consist of: 1) a missile packaged in a tube; 2) a launching mechanism (commonly known as a "gripstock"); and 3) a battery. The tubes, which protect the missile until it has been fired, are disposable. Rudimentary sights are mounted on the tube. A single-use battery is typically used to power the missile prior to launch ... There are three main types of MANPADS: 1) Infrared (IR) systems that hone in on an aircraft's heat source, usually the engine or the engine's exhaust plume; 2) Command Line-of-Sight (CLOS) systems whereby the MANPADS operator visually acquires the target aircraft using a magnified optical sight, and then uses radio controls to guide the missile into the aircraft; and 3) Laser Beam Riders in which the missile flies along the laser beam and strikes the aircraft where the operator has aimed the laser... Although superficially similar in appearance, MANPADS should not be confused with rocket-propelled grenades (RPGs). RPGs are also portable and shoulder-fired. However, RPGs are unguided weapons designed primarily to be used against ground targets and are generally ineffective against aircraft, except at very close range. Some RPG attacks on low-flying aircraft have been mistaken for MANPADS attacks."

⁶⁷ Michael Wines, "Beijing in a Bind With Libyan Rebels; State Arms Firms Talked with Qaddafi Regime, But Chinese Deny Deliveries," *The International Herald Tribune*, September 6, 2011.

reported that “thousands of shoulder-held surface-to-air missiles (SAMs) are unaccounted for. At one unguarded facility, empty packing crates and documents reveal that 482 sophisticated Russian SA-24 missiles were shipped to Libya in 2004, and now are gone. With a range of 19,000 feet, the SA-24 is Moscow’s modern version of the American ‘Stinger,’ which in the 1980s helped the U.S.-backed Afghan mujahedeen turn their war against the Soviet Union.”⁶⁸ This is but one example of how high tech weaponry can spread from a major state actor (Russia) to a minor state actor (Libya) to possibly the black market and terrorist entities.

Iran

Given current tensions with Iran and its perceived intent to develop a wide range of sophisticated weapons, Iranian precision strike and counter precision strike capabilities are of concern to the United States. One analyst notes,

The second concern is Iran, which, like Beijing, is buying into the precision-guided weapons revolution. Its ‘poor man’s’ version of China’s arsenal includes long-range ballistic missiles, supersonic anti-ship cruise missiles, smart anti-ship mines and fast attack boats to ‘swarm’ enemy ships. The apparent goal is to turn the Persian Gulf’s constricted waters, through which 40 percent of the world’s oil shipping passes, into an Iranian lake. This challenge is compounded by Iran’s efforts to acquire a nuclear capability, which may encourage it to become more aggressive in its efforts to undermine regional security.⁶⁹

In addition, according to the Director of the Defense Intelligence Agency, “Iran is making progress in developing ballistic missiles that can strike regional adversaries and central Europe. In addition to its growing missile and rocket inventories, Iran is boosting the lethality and effectiveness of existing systems with accuracy improvement, new munitions, and salvo launches. Iran’s Simorgh space launch vehicle shows the country’s progress toward developing an intercontinental ballistic missile.”⁷⁰

High Precision Anti-Tank Rockets

In August 2011, Iran’s Defense Minister, Brigadier General Ahmad Vahidi, reported that Iran’s defense industry has begun producing a line of anti-tank rockets with the capacity to destroy tanks, armor, and enemy ammunition depots. “The rocket strong warhead enables objects to be destroyed at a distance of 1,300 meters—it is light-weight with high precision to strike. It plays an important role in close combat and distant strikes,” he said.⁷¹ The precision strike capability of this new anti-tank weapon sets it apart from Iran’s other anti-tank rockets, which are primarily simple aimed projectiles. Moreover, Iran has a history of proliferating weapons to both state and nonstate actors such as Hezbollah, Hamas, and the Palestinian Islamic Jihad.

⁶⁸ Scott Peterson, “The Deadly Dilemma of Libya’s Missing Weapons,” *The Christian Science Monitor*, September 7, 2011.

⁶⁹ Andrew F. Krepinevich, “Panetta’s Challenge,” *The Washington Post*, July 15, 2011.

⁷⁰ Written testimony to the Senate Armed Services Committee by Ronald Burgess, Director of the Defense Intelligence Agency, *The Current and Future Worldwide Threats to the National Security of the United States*, March 10, 2011.

⁷¹ “Iran to Begin Mass Production of Anti-Tank Rockets,” *Trend Daily News (Azerbaijan)*, August 29, 2011.

Iranian-Made Cruise Missile

Iran claims to have developed a precision strike cruise missile. According to the Associated Press,

Tehran ... put on display a new Iranian-made cruise missile, which it says has a range of 124 miles and is capable of destroying a warship. The cruise missile, designed for sea-based targets, is the latest addition to Iran's growing arsenal. President Mahmoud Ahmadinejad attended a ceremony ... that showed off the weapon, dubbed "Ghader," or "Capable" in Farsi. Iranian state TV says it can travel at low altitudes and has a lighter weight and smaller dimensions. Iran has an array of short and medium-range ballistic missiles capable of hitting targets in the region, including Israel and U.S. military bases in the Gulf. In 2010, Tehran displayed other Iranian-made cruise missiles but with a shorter range.⁷²

On January 2, 2012, Iran successfully test fired the new missile during a naval exercise practicing closing the Strait of Hormuz.

Strait of Hormuz⁷³

The strategic importance of keeping the Strait of Hormuz open cannot be overstated. The Strait of Hormuz is a narrow passageway connecting the Persian Gulf with the Gulf of Oman and the Arabian Sea and separating Iran from the Arabian Peninsula. It is one of the world's vital oil transit chokepoints. The northern tip of the United Arab Emirates (UAE) forms the southern shoreline of the strait. The UAE, officially created in 1971, is a constitutional federation made up of Abu Dhabi, Dubai, Sharjah, Ajman, Umm al-Quaiwain, Ras al-Khaimah, and Fujairah. The Strait consists of 2-mile wide channels for inbound and outbound tanker traffic, as well as a 2-mile wide buffer zone.

Two-thirds of the world's oil is transported by ocean; straits and canals are therefore vital in reducing the time and costs of transporting oil, as well as other goods, globally. Any political disturbances or upheavals can cause the "choking" of the few important straits for world oil transit and thus disrupt world oil prices. Roughly 17 million barrels, or 40% of the world's oil, passes through the Strait of Hormuz daily.

⁷² Associated Press, "Iran Shows Off New Cruise Missile," *NYTimes.com*, August 23, 2011.

⁷³ Alejandra Roman, "Strait of Hormuz," *The Encyclopedia of Earth*, June 14, 2007.

Figure 8. Strait of Hormuz



Source: Inside of Iran at <http://www.insideofiran.org/en/categoryblog/1753-Iran-guards-ready-to-close-strait-of-hormuz.html>.

UPI reported in February 2011 that Iran announced it is mass-producing ballistic missiles that can travel three times the speed of sound and hit naval targets on the high seas. The head of Iran's elite military force, the Revolutionary Guard, said the missile has a range of 186 miles, is able to hit targets using high precision, and cannot be tracked. "The announcement of the new missile comes as Iran had celebrations to mark the 32nd anniversary of its Islamic revolution, which toppled the U.S.-backed Shah ... and the announcements sound a day after the chief of Iran's Revolutionary Guard warned it would close the Strait of Hormuz if Iran were to be threatened."⁷⁴

U.S. defense analysts have said that Iran's Navy does not have the size for a sustained physical blockade of the Strait, but does have mine-laying and precision strike missile capability to temporarily close the Strait. The U.S. Fifth Fleet is based in nearby Bahrain reportedly keeping a close eye on Iranian activity and stated in a press conference that "any disruption will not be tolerated."⁷⁵ Iran's development of a precision strike guided missile could potentially increase the difficulty of keeping the Strait open.⁷⁶

⁷⁴ "Iran Tests Anti-Ship Missiles," *UPI*, February 9, 2011.

⁷⁵ Tabassum Zakaria, "Closing Strait of Hormuz Not So Easy For Iran: Analysts," *Reuters*, December 28, 2011.

⁷⁶ For more on Iran's threat to the Strait of Hormuz, see CRS Report R42335, *Iran's Threat to the Strait of Hormuz*, coordinated by Kenneth Katzman and Neelesh Nerurkar.

Russia

Drones

The use of unmanned aerial vehicles (UAVs) by the United States has demonstrated the capabilities and battlefield advantages that can be had by the use of such technology.⁷⁷ From giving commanders aerial footage of the battlefield to launching precision strikes killing terrorists, their role has been ever expanding. Russia joined the armed UAV capable nations on September 2, 2011, when it introduced its first armed UAV, named “Lutch.” The aircraft can carry over 350 pounds of “guided weapons on fuselage pylons including missiles. The pilotless aircraft is designed for optical reconnaissance, radar, radio-relay and electronic reconnaissance missions.”⁷⁸ Based on the Sigma 5 aircraft, it has a 250-350 kms surveillance range, which can be augmented to 500 kms. It can stay in the air for up to 18 hours and can be extended to 30 hours with additional fuel tanks attached. Once operational, these drones could be exported to both state and non-state actors unfriendly toward the United States and its allies. Even so, in order for these systems to fire precision weapons they would need to be utilized as part of a much larger, more complex informational battle space to fully exploit their capabilities.

Club K Cruise Missile

A Russian defense company is currently marketing a new cruise missile system that can be hidden inside a standard shipping container. The housing of the system blends in with the hundreds of thousands of shipping containers used every day in carrying the world’s commerce. Some defense experts have expressed fear that a weapon with such camouflage capability could give any merchant vessel the capability to wipe out an aircraft carrier. A Reuters story on the new system reports, “Potential customers for the formidable Club-K system include Kremlin allies Iran and Venezuela ... and countries could pass on the satellite-guided missiles, which are very hard to detect, to terrorist groups.”⁷⁹

The complete Club-K system is thought still to be primarily a marketing concept, although the basic components of the system all exist as individual items and a full-size, articulated mock-up was on display at the MAKS 2011 air show in Moscow.⁸⁰ The system’s maker, “Concern Morinformsystem-Agat, is clearly looking for a customer willing to pay the sums needed to complete development and integration of the finished system.”⁸¹ It is estimated the cost for the Club-K system is between \$10 million and \$20 million. For this reason, proliferation to non-state actors “is unlikely as the manufacturer needs a serious paying customer—at state level—to complete the Club-K.”⁸²

⁷⁷ For more on U.S. unmanned capabilities, see CRS Report R42136, *U.S. Unmanned Aerial Systems*, by Jeremiah Gertler.

⁷⁸ Vinay Shukla, “Russia to Unveil Armed Drones at Moscow Airshow,” *The Press Trust of India*, August 10, 2011.

⁷⁹ Reuters, “Deadly New Russian Weapon Hides in Shipping Container,” *Times of Oman*, April 27, 2010.

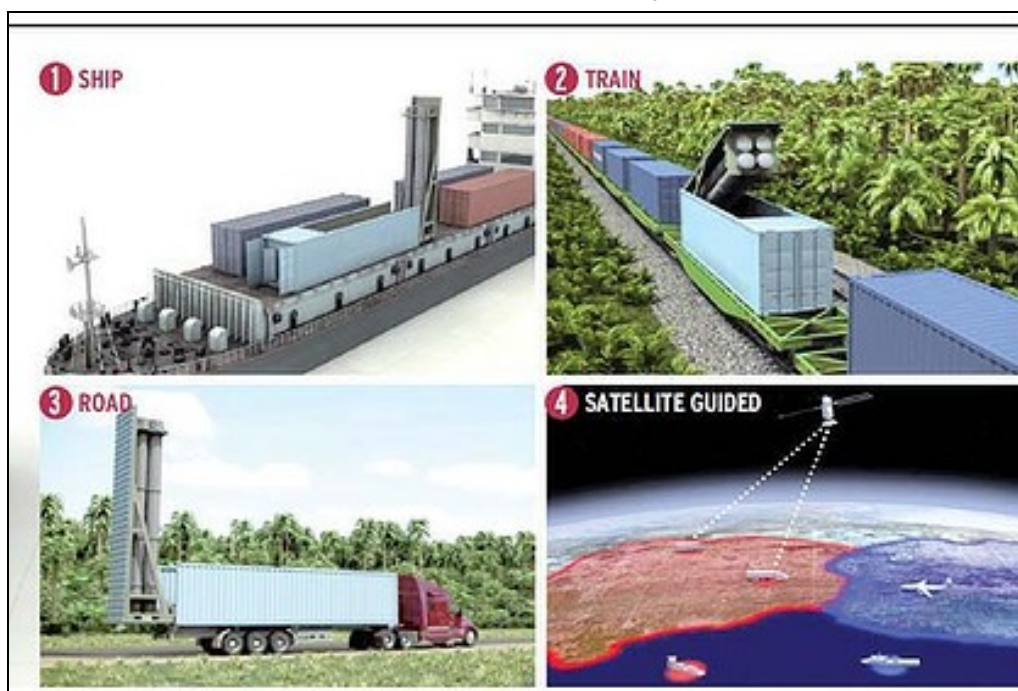
⁸⁰ Robert Hewson, “Containerized Club-K Out in the Open at MAKS,” *Jane’s Defence Weekly*, August 25, 2011.

⁸¹ Robert Hewson, “Concealed Club-K Establishes a New Dimension in Cruise Missile Deployment,” *Jane’s Navy International*, May 24, 2010.

⁸² Ibid.

In terms of the system's elements, "Each Club-K CMS incorporates four missile tubes, elevated as a single unit to launch vertically from their transport container (dubbed the Universal Launching Module, ULM). The complete system requires a combat-management module (CMM) and energy-supply and life-support module (ES & LSM). All these components are housed in similar standardized container modules. According to Concern Morinformsystem-Agat's own information the Club-K ULM can be carried by and launched from commercial ships, flatbed railway trucks and regular articulated road haulage vehicles."⁸³

Figure 9. Club-K
Containerized Cruise Missile System



Source: Sydney Morning Herald at <http://www.smh.com.au/world/covert-cruise-missile-20100426-tn8e.html>.

If true, for anyone with the money to buy one, the Club-K has the potential to give long-range precision strike capability to ordinary vehicles that can be moved around without attracting attention.

On the other hand, the Club-K system requires a relatively sophisticated level of targeting data to be used effectively. A user needs precise geo-location data and/or the ability to conduct some level of over-the-horizon targeting to fully exploit the weapon. For use against large infrastructure targets this requirement is less demanding. For use against moving targets at sea, missiles require accurate positional data on targets before launch and then they must rely on the radar seeker to pick out the final target in the terminal phase. The seeker has the ability to assess target size and, therefore, (approximate) target type. Ideally, however, the anti-ship weapon would receive some form of mid-course guidance update support to improve its precision strike capability.

⁸³ Ibid.

SA-24 “Grinch” Surface to Air Missiles to Venezuela

The potential sale of up to 2,400 Russian SA-24 “Igla-S” or “Grinch” missiles to Venezuela has created concern. The Igla-S (Igla-Super or Special) has been designed to engage front-line aircraft, helicopter, cruise missiles, and Unmanned Aerial Vehicles (UAVs) under direct visibility conditions both day and night. The system can take a target from both the head-on and tail chase in background clutter and thermal countermeasures environments.”⁸⁴

Media reports have described the Grinch:

The Igla-S system (SA-24) became available in the mid-2000s. The missile itself ... is claimed to outperform its predecessors in effectiveness, reliability, service life and survivability. In addition, the system retains all merits of the previous Russian Man-Portable Surface-to-Air Missile Systems (MANPADs); shoulder firing by a single gunner, “fire-and-forget” concept, high resistance to background clutter and thermal countermeasures, easy aiming and launching, easy maintenance and training, high covertness of use, retained operability in extreme operational environments.⁸⁵

In 2010, U.S. Air Force General Douglas Fraser expressed concern that Venezuela was purchasing as many as 2,400 SA-24 MANPADs, which are considered to be some of the most sophisticated systems in the world and can down aircraft up to 19,000 feet above the ground. “It’s the largest recorded transfer in the U.N. arms registry database in five years, at least. There’s no state in Latin America of greater concern regarding leakage that has purchased so many missiles ... referring to reports of Venezuelan arms flowing to Colombian guerrillas.... The Chavez regime also has close ties with Hezbollah and Iran.”⁸⁶

Figure 10. SA-24 ‘Grinch’ Surface to Air Missile (SAM)



Source: Cleaves Newswire at http://cleaves.zapto.org/news/story_2803.html.

⁸⁴ “KBM Kolomna 9M342 Igla-S (SA-24 ‘Grinch’) Man-Portable Anti-Aircraft Missile,” *Jane’s Electro-Optic Systems*, January 20, 2011.

⁸⁵ Juan Forero, “Venezuela Acquires 1,800 Anti-Aircraft Missiles From Russia,” *The Washington Post*, December 11, 2010.

⁸⁶ Ibid.

Potential Implications for Enemy Precision Strike Capabilities Against U.S. Forces

Pentagon planners have considered the potential impact of the loss of U.S. precision strike dominance on future military operations.

The observation that U.S. opponents will employ asymmetric capabilities and strategies to counter American conventional military superiority has been made frequently over the past decade. This phenomenon is not new, however, nor is it limited to land warfare. Throughout the 19th and early 20th centuries rival nations sought to compete with British naval power while conserving their own resources by developing new weapons platforms, utilizing the inherent advantages of land-based firepower, and exploiting Britain's dependence on overseas resources and extended lines of communication. Although these efforts often failed due to technological and political constraints, in several cases they are being revived today by existing and prospective U.S. opponents, many of whom have a greater incentive to compete asymmetrically than their predecessors given the scale of U.S. dominance, in addition to having access to capabilities far superior in range, accuracy, and endurance than those employed a century ago. Most importantly, however, although it appears increasingly clear that nations such as China and Iran are pursuing these asymmetric capabilities and strategies, they are unlikely to be the only ones.⁸⁷

Many observers believe that “future adversaries are developing sophisticated new anti-access networks with long-range targeting capabilities, as well as advanced conventional missiles of greater range and precision that can attack both fixed land targets and ships at sea. In future crises, these developments could put some of the U.S.’s most prized Navy and joint-force assets at risk from far greater ranges than before. In other words, these developments threaten to eliminate the virtual operational sanctuaries the U.S. Navy-Marine Corps and joint team has enjoyed since the end of World War II.”⁸⁸

The following are a few theoretical examples of the impacts on U.S. expeditionary warfighting that can potentially occur as precision strike capabilities grow and proliferate.

Forward Operating Bases (FOBs)

Setting up and using FOBs in Afghanistan over the past decade, coupled with the increased proliferation in precision guided weapons, has led some military experts to contend that forward-deployed troops could be much more vulnerable in the future to enemy munitions such as rockets and mortars. To address this issue, in the fall of 2011, the Naval Research Advisory Committee—which advises the Office of Naval Research on how to apply science, research and development to the Navy and Marine Corps—was tasked with conducting a study for countering precision weapons. Reportedly, the draft terms of reference for the study on Marine Corps capabilities for countering precision weapon threats warns of an emerging potential for U.S. adversaries to adopt

⁸⁷ “The Proliferation of Precision-Guided Weapons and the Future of Naval Irregular Warfare: Assessment and Implications,” *Center for Strategic and Budgetary Assessments (CSBA)* prepared for the Office of Net Assessments, Office of the Secretary of Defense, September 2010.

⁸⁸ Robert O. Work and F. G. Hoffman, “Hitting the Beach in the 21st Century,” *United States Naval Institute: Proceedings*, November 2010.

and employ precision weapons and munitions to improve their lethality. The goal of the study is to identify challenges for countering precision munitions and recommend opportunities to address this potential challenge.

The Naval Research Advisory Committee continues stating,

We saw the emergence of Forward Operating Bases (FOBs) during operations in Afghanistan, from which the Marine Corps sustains, deploys from, and accomplishes missions against the enemy with small units (squads to companies).... Should these FOBs become subject to precision enemy fire, the Afghanistan mission risk will increase. The Intel [sic] community is seeing greater proliferation of relatively inexpensive Guided Rockets, Artillery, Mortars and Missiles (G-RAMM), which can pose a great threat to future Marine operations. This threat is yet another example of cheap technologies with the potential to have a huge impact on future missions, much like the [improvised explosive devices] have had on recent ones.⁸⁹

An example of how this could drastically affect operations occurred approximately five years ago:

During its war with Israel in 2006, Hezbollah fired more than 4,000 relatively inaccurate RAMM projectiles—rockets, artillery, mortars and missiles—into Israel, leading to the evacuation of at least 300,000 Israelis from their homes and causing significant disruption to that country's economy. Out of these thousands of munitions, only a few drones and anti-ship cruise missiles were guided. But as the proliferation of guided munitions—G-RAMM weapons—continues, irregular warfare will be transformed to the point that the roadside bomb threats that the United States has spent tens of billions of dollars defending against in Iraq and Afghanistan may seem trivial by comparison.⁹⁰

If a greater percentage of the 4,000 projectiles had been guided, the amount of damage and suffering they caused would have undoubtedly been significantly higher.

The same relationship holds true for U.S. forward deployed troops. Some of the larger FOBs in Afghanistan also have airfields from which USAF, USA and USMC aviation platforms operate. The threat to operations would likely be much greater if the Taliban or another adversary fired a barrage of G-RAMM toward the personnel and equipment. A trained and experienced adversary would have the capability to target specific aircraft or troop facilities with impunity. The resulting casualty rate has the potential to be harmful and may require counter-assets that are capable of successfully targeting and defending against such a threat.

Carrier Operations

The growing threat to carrier operations has been mentioned earlier in this report. It is a potential threat to U.S. Navy operations that many experts believe cannot be ignored. One main aim of carrier operations is the U.S. ability to project power anywhere in the world:

Power projection, broadly defined to include amphibious operations, has numerous strategic benefits. It can serve to deter many forms of aggression, because aggressors will realize that

⁸⁹ InsideDefense.com, "Panel Plans Studies On Countering Guided Munitions and BA4 Account," August 24, 2011.

⁹⁰ Andrew Krepinevich, "Get Ready for the Democratization of Destruction," *Foreign Policy*, September 2011.

we can respond appropriately if they try to take a preemptive action. It assures allies of U.S. capability to intervene decisively on their behalf, with forces that can regain ground or compel compliance. It provides the ability to gain and exploit operational access into theaters at a time and place of U.S. choosing, regardless of political or geographical limitation. Finally, it serves as a key element of a cost-imposing strategy to make expensive demands on any potential adversary's plan.⁹¹

Some experts believe that given the very clear

technology trends toward precision long-range strike and increasingly sophisticated anti-access and area-denial capabilities, high-signature, limited-range combatants like the current aircraft carrier will not meet the requirements of tomorrow's Fleet. In short, the march of technology is bringing the super carrier era to an end, just as the new long-range strike capabilities of carrier aviation brought on the demise of the battleship era in the 1940s. Factors both internal and external are hastening the carrier's curtain call. Competitors abroad have focused their attention on the United States' ability to go anywhere on the global maritime commons and strike targets ashore with pin-point accuracy. That focus has resulted in the development of a series of sensors and weapons that combine range and strike profiles to deny carrier strike groups the access necessary to launch squadrons of aircraft against shore installations.⁹²

Others believe carriers will not disappear so quickly, but changing enemy capabilities must still be addressed. As such, in the future the U.S. may not have the luxury of being able to position forces forward for a period of time so they can commence fighting at a time and in a manner of their choosing. Quite possibly forces will be more vulnerable to attack forcing U.S. maritime forces to be positioned farther away from shore. If this is the case, then new systems would be needed to help U.S. forces fight through a precision strike network en route to the battlefield.

Amphibious Assault

The U.S. Marine Corps amphibious assault capability has been a key mission for many years. With the advent of precision weaponry, some analysts believe this capability is in question:

For example, land-based anti-ship cruise missiles could pose a significant danger to amphibious ships operating over-the-horizon, assuming that initial targeting data could be gathered by UAVs, spotters on civilian vessels, or coastal radars (if amphibious ships were operating relatively close to shore). This situation could grow even more dangerous if advanced Anti-Ship Cruise Missiles (ASCMs) such as the Russian-designed Sizzler—which is capable of supersonic closing speeds and terminal maneuvers, making point defenses against them extremely difficult—become more widely available. Closer to shore, elements of an amphibious assault force could be vulnerable to shorter-range precision weapons. Landing Craft Air Cushions (LCACs), for instance, could be targeted by Anti-Tank Guided Missiles (ATGMs) or short-range missiles located on land near the shoreline, while guided mortars would present an anti-personnel threat that would be difficult to counter, particularly if enemy units were dispersed, highly mobile, and camouflaged by complex terrain.

⁹¹ Robert O. Work and F. G. Hoffman, "Hitting the Beach in the 21st Century," *United States Naval Institute: Proceedings*, November 2010.

⁹² Henry J. Hendrix and J Noel Williams, "Twilight of the Superfluous Carrier," *United States Naval Institute: Proceedings*, May 2011.

Airborne insertion as well as aerial reconnaissance and fire support could prove equally difficult when adversaries possess even rudimentary reconnaissance-strike complexes.⁹³ An opposing force equipped with Man-Portable Surface-to-Air Missile Systems (MANPADs) and a basic radar system could pose a major threat to rotary-wing platforms, particularly if it employed swarming tactics to attack from multiple angles and utilized the cover of a dense urban environment. More advanced systems, such as truck mounted medium range anti-air missiles, could pose an even greater threat, even against low-to-medium altitude fixed-wing aircraft.⁹⁴

Adversary precision strike capability against an amphibious assault presents several challenges to current U.S. Navy and Marine Corps operational concepts. An analysis prepared for DOD by the Center for Strategic and Budgetary Assessment says, “First, when facing an opponent that is equipped with ATGMs and precision-guided mortars, efforts to establish a secure beachhead may become prohibitively costly because any large concentration of forces could be the target of extremely accurate attacks that will be difficult to prevent. Second ...the proliferation of land-based ASCMs could enable an opponent to target high signature amphibious assault ships at even greater distances, forcing those ships to make a difficult choice: accept the risk of an attack or operate from beyond the maximum range of their assault vehicles.”⁹⁵

For these reasons, some analysts criticize the Navy’s amphibious assault requirements against this new precision strike challenge. However, some analysts believe that as precision-guided weapons proliferate more widely, a very good case can be made that a forcible entry capability is more valuable than it has been during the recent past:

For example, if staging areas for ground troops grow increasingly vulnerable to both short- and long-range guided munitions, then deploying forces over an extended period of time and massing them at a small number of locations close to a theater of operations—both of which are hallmarks of post-Cold War American power-projection—may no longer be tenable. Commanders, for example, may be unable to adequately defend forward staging areas and reluctant to put troops in harm’s way before an operation even begins, while host nations may be unwilling to accept the possibility of retaliation against their territory. In theory, troops could be dispersed to a greater number of locations to complicate an enemy’s targeting problem, but this would exacerbate political problems (by relying on access from additional countries) and introduce new operational and logistical challenges, in particular supplying and coordinating more widely-dispersed forces. An amphibious assault force, by contrast, could assemble quickly and would not be dependent on the consent of U.S. allies. Alternatively, against an opponent equipped with only a modest Guided Rockets, Artillery, Mortars and Missiles (G-RAMM) inventory, an amphibious assault force could compel the adversary to expand its target set, thus limiting the overall impact of its guided weapons.⁹⁶

⁹³ A reconnaissance-strike complex refers to the integration of precision-guided weapons that receive information from area sensors and/or radar systems tied together with a command and control element.

⁹⁴ “The Proliferation of Precision-Guided Weapons and the Future of Naval Irregular Warfare: Assessment and Implications,” *Center for Strategic and Budgetary Assessments (CSBA)* prepared for the Office of Net Assessments, Office of the Secretary of Defense, September 2010.

⁹⁵ Ibid. For more information, see CRS Report RS22947, *The Marines’ Expeditionary Fighting Vehicle (EFV): Background and Issues for Congress*, by Andrew Feickert.

⁹⁶ “The Proliferation of Precision-Guided Weapons and the Future of Naval Irregular Warfare: Assessment and Implications,” *Center for Strategic and Budgetary Assessments (CSBA)*, prepared for the Office of Net Assessments, Office of the Secretary of Defense, September 2010.

In a 2011 House Armed Services Committee joint hearing on Seapower and Projection Forces Outlook, Lieutenant General Richard Mills, Deputy Commander for Combat Development and Integration at the Marine Corps Combat Development Command, reiterated his staunch support for the relevance of USMC amphibious assault capabilities. Part of his testimony follows:

The Marine Corps and amphibious warfare go back, as you know, quite a while. The initial question we had to answer was: Was amphibious warfare even feasible back in the 1930s as we began to look at an expanding Japanese threat in the Pacific? There were many people back there who said no, it was not a feasible military strategy and was foolish for us to pursue and try to train and equip our forces to do so. I think the success, obviously, in World War II as it evolved and as our tactics changed and our equipment changed, in proven fact, that was a very feasible strategy.

In the years since World War II, time and time again, the feasibility of amphibious operations has been questioned, whether it be in 1949 when it was General Bradley who questioned the very idea that an amphibious attack were ever to take place again, followed very shortly thereafter, of course, by the Inchon landing and what many people would describe as the decisive stroke of the Korean War.

Each time, things have changed. The threat's been more. People have questioned whether or not that was still a feasible military operation. Each time, I think, the Navy and Marine Corps team, backed by the entire joint community, has proven in fact not only is it feasible, but it's extraordinarily valuable as you pursue operations whether across the entire spectrum of military operations, everything from humanitarian relief to full combat operations.

So, I would say that those who question the ability of amphibious forces to conduct operations today just don't understand the way that we constantly study, that we constantly adapt, that we constantly change. And we face a threat and we believe that we can overcome it.⁹⁷

Issues for Congress

Congressional Oversight of Plans and Programs—Technology

This report highlights a growing number of precision strike weapons and threats that are becoming available to both state and non-state actors, as well as the increasing potential for proliferation. These developments pose a number of potential issues for Congress that could have a direct impact on U.S. national security. One issue for Congress in its oversight role is whether DOD is properly preparing for potential future conflicts by taking adversary precision strike weapons into account. Doing so requires both acquiring the appropriate capabilities to counter these challenges and developing effective doctrine for exploiting them. Congressional oversight could focus on both aspects.

The following are a few potential U.S. military technologies that could be used to combat the growing precision strike threat. This list is a sampling and not meant to be all-encompassing.

⁹⁷ Lt. Gen Richard Mills, Congressional testimony on “Seapower and Projection Forces Outlook”, *Deputy Commander for Combat Development and Integration*, November 3, 2011.

Fifth Generation Fighter

The United States is the only country that currently possesses an operational fifth generation fighter—the F-22 Raptor. According to the F-22 Raptor Team (Boeing and Lockheed Martin) website, the “F-22 Raptor is the world’s first stealthy air dominance fighter and is capable of multiple missions. Deadly and unseen at long range, unmatched at close-in dogfighting and with superb, precision-strike ground attack capabilities, the F-22 will establish absolute control.”⁹⁸ The Air Force originally planned to procure 750 F-22s to replace the aging F-15A-D fleet. Due to budgetary constraints and cost overruns, the program eventually ended with a final production target of 187 aircraft, well below the original 750 planned. Both China and Russia are currently producing their version of a fifth generation fighter with precision strike capabilities, some analysts argue, that could potentially challenge the F-22 and U.S. air superiority/supremacy dominance.

Congress may wish to look at the costs and possibilities of restarting the production line should these new threats bear fruit. In addition, it also may look to the Air Force to begin research and development of a sixth generation fighter to ensure technological dominance from the air in terms of precision strike, as well as the ability to fight in any anti-access/area denial environment. Both of these options would be expensive. For example, a study completed in 2009 showed “the production of an additional 75 F-22s beyond the ... 187 units would increase per-unit cost by an estimated \$70 million if the production line were ... to be re-opened.”⁹⁹

Aegis Combat System

The Aegis combat system has served the U.S. well for a number of years. Many observers speculate, though, the current Aegis system might not be able to protect adequately against anti-ship missiles such as China’s DF-21D. They state the Aegis system was not designed for this type of threat and is vulnerable. A description of the Aegis combat system follows:

Aegis, which means shield, is the Navy’s most modern surface combat system. Aegis was designed and developed as a complete system, integrating state-of-the-art radar and missile systems. The Aegis Combat System is highly integrated and capable of simultaneous warfare on several fronts—air, surface, subsurface, and strike. Shipboard torpedo and naval gunnery systems are also integrated. Anti-Air Warfare elements of the Aegis Weapon System MK-7, a component of the Aegis Combat System, include the Radar System AN/SPY-1B/D, Command and Decision System, and Weapons Control System. This

Figure 11. F-22 Raptor

5th Generation Fighter Aircraft



Source: Defense Industry Daily at <http://www.defenseindustrydaily.com/F22-raptors-to-Japan-01909/>.

⁹⁸ Information taken from <http://www.f22-raptor.com/about/history/html> on November 17, 2011. Additional information regarding the F-22 can be found at <http://www.boeing.com> and <http://www.lockheedmartin.com>, as well as a CSIS report titled “America’s Self-Destroying Airpower.”

⁹⁹ Joachim Hofbauer, “Defense Industrial Initiatives #5: The Cost of Cutting Defense Acquisition,” *CSIS*, January 30, 2009.

makes the Aegis system the first fully integrated combat system built to defend against advanced air, surface, and subsurface threats.

The Aegis Combat System (ACS), which is the center of the Arleigh Burke-class destroyers and Ticonderoga-class cruisers, relies on a separate sonar system to track undersea threats like mines, torpedoes, and submarines. The complete package can simultaneously follow land, air, and undersea threats and attacks. The SPY-1A and -1B radar classes are designed for the cruisers, while the -1D class is for the destroyers. The letter “V” in SPY-1D(V) means variant.

The complete integration of all these systems serves to enhance the capability of a ship to engage and defeat numerous multi-warfare threats simultaneously. The computer-based command-and-decision element is the core of the Aegis combat system. This interface makes the Aegis combat system capable of simultaneous operation against almost all kinds of threats. The Aegis system is being enhanced to act in a Theater Missile Defense role, to counter short- and medium-range ballistic missiles of the variety typically employed by rogue states.¹⁰⁰

An oversight issue for Congress is to verify with the U.S. Navy the current capabilities of the Aegis Combat System. Does it currently allow for adequate protection against missiles such as the DF-21D? Does this protection also include a barrage attack and how effective is the system against this threat every time? Some experts believe that the current Aegis system will require a significant logistical train to support kinetic action against incoming projectiles.

Naval Research Advisory Committee’s Counter G-RAMM Study

As mentioned earlier, the Naval Research Advisory Committee plans to study U.S. Marine Corps capabilities for countering precision weapons. The study is slated to characterize known and potential precision weapons and munitions types that could be potentially exploited by hostile governments and non-state actors, to include relatively inexpensive, home-made weapons. In addition, according to one source,

the panel will review and assess the current and planned Marine Corps policies, strategies, approaches (including training), and capabilities for responding to these potential precision weapons and munitions.

Further, the panel must identify promising science and technology areas for Marine Corps capabilities that could help detect, track, identify, and engage precision weapons while countering damage caused by the weapons. The study would also recommend any other steps the Marine Corps should take to address the threat posed by precision weapons.¹⁰¹

All Services are affected by this technology, however, with the greatest impact being on the Army and Marine Corps. An issue for Congress is whether or not the entire DOD is taking the proliferation of G-RAMM technology and weapons into account in its programming of future weapon systems? In addition, Congress could ask the Services for a briefing detailing work that has been, is being, or is projected to be done on countering precision G-RAMM weapons.

¹⁰⁰ See <http://www.globalsecurity.org/military/systems/ship/systems/aegis.htm>.

¹⁰¹ InsideDefense.com, “Panel Plans Studies On Countering Guided Munitions and BA4 Account,” August 24, 2011.

Strategic Precision Strike Plans and Programs

The following examples have received attention in various defense publications as well as among think tanks. A related issue for Congress is whether DOD is adequately preparing for current and future containment strategies, such as China's rising anti-access/area denial efforts, which incorporate numerous precision strike platforms and weapons.

AirSea Battle¹⁰²

Appreciating the need to address the growing challenge posed by the emerging A2/AD environment, the Secretary of Defense directed the Department of the Air Force and the Department of the Navy to develop an AirSea Battle concept as announced in the 2010 Quadrennial Defense Review (QDR). (Very little in terms of specificity has been released regarding AirSea Battle, as it still remains a highly classified program.)

In response, the services designed an operational concept, focused on the ways and means necessary to neutralize current and anticipated A2/AD threats, to ensure our Joint force maintains the ability to project power and protect U.S. national interests.

The AirSea Battle Concept centers on networked, integrated, attack-in-depth to disrupt, destroy and defeat (NIA-D3) A2/AD threats. This approach exploits and improves upon the advantage U.S. forces have across the air, maritime, land, space and cyberspace domains, and is essential to defeat increasingly capable intelligence gathering systems and sophisticated weapons systems used by adversaries employing A2/AD systems. Offensive and defensive tasks in AirSea Battle are tightly coordinated in real time by networks able to command and control air and naval forces in a contested environment. The air and naval forces are organized by mission and networked to conduct integrated operations across all domains.¹⁰³

The concept organizes these integrated tasks into three lines of effort:

1. Air and naval forces attack-in-depth to disrupt the adversary's intelligence collection and command and control used to employ A2/AD weapons systems;
2. To destroy or neutralize A2/AD weapons systems within effective range of U.S. forces;
3. To defeat an adversary's employed weapons to preserve essential U.S. Joint forces and their enablers.

"Through NIA-D3, air and naval forces achieve integrated effects across multiple domains, using multiple paths to increase the resilience, agility, speed and effectiveness of the force."¹⁰⁴ DOD announced at the beginning of November 2011 the establishment of a new AirSea Battle office, which will "coordinate military and interagency efforts related to AirSea Battle; supervise how

¹⁰² For additional information and Congressional issues on AirSea Battle see CRS Report RL33153, *China Naval Modernization: Implications for U.S. Navy Capabilities—Background and Issues for Congress*, by Ronald O'Rourke.

¹⁰³ USMC Issued Statement on the AirSea Battle Concept, "The AirSea Battle Concept Summary," *U.S. Fed News*, November 10, 2011.

¹⁰⁴ *Ibid.*

the concept is implemented in terms of organizing, training, and equipping forces; and guide, facilitate and monitor the execution of AirSea Battle force development.”¹⁰⁵

Proponents of the concept say it promotes interoperability between the Services, stressing the importance of incorporating this interoperability into the acquisition cycle of new weapon systems, thus improving tactical results/competency and cost effectiveness. Even though a Taiwan scenario against China is the obvious example, the concept has supposedly been developed to work in any generic A2/AD situation. Finally, the AirSea Battle concept combined with the effective use high-tech weaponry should allow the United States to break the enemy precision strike kill chain in a number of areas helping preserve U.S. power projection and freedom of access capabilities.

Critics, on the other hand, raise a potential negative issue with the concept that deals with escalation. Many question how China, a nuclear power, would react to strikes on its mainland.

AirSea Battle is intended to inject significant uncertainty into the calculations of adversaries, ideally so that conflict doesn't occur in the first place. This objective of deterring the enemy from initiating acts of aggression in the first place is laudable, but it's also worth considering escalation control. While the AirSea Battle concept is still not presented in detail publicly and its future is unclear, some have noted the escalatory dynamics that lurk within the concept itself. Should deterrence collapse, it is important to keep the conflict as limited as possible, so starting a conflict at the upper end of the escalation ladder would seem to be flawed strategic thinking.¹⁰⁶

A potential issue for Congress could be the risk to the U.S. associated with the aforementioned escalation dynamics.

A second potential issue for Congress stemming from the AirSea Battle concept is whether DOD is focusing the concept in a broad strategic context or responding solely to a Taiwan-China scenario. Although a Taiwan scenario is probably the most complex, should the final concept be applicable world-wide since substantial funding and weapon acquisition decisions may be based upon it?

Thirdly, Congress may consider the implications of how AirSea Battle accounts for “geostrategic factors, such as U.S. treaty and legal obligations to defend formal allies and friends in the region. Even more importantly, AirSea Battle is not a U.S. only concept. Allies such as Japan and Australia, and possibly others, must play important enabling roles in sustaining a stable military balance.”¹⁰⁷

Finally, a potential oversight issue for Congress is the effectiveness of the AirSea Battle concept in countering developing military vulnerabilities in the region: “U.S. ground, air and naval forces have long been accustomed to operating from sanctuary.... The growing Chinese A2/AD capabilities, to include its cyber weapons, threaten to violate these long-standing sanctuaries.”¹⁰⁸

¹⁰⁵ Christopher J. Castelli, “Pentagon Poised to Announce New Multi-Service AirSea Battle Office,” *Inside the Pentagon*, November 3, 2011.

¹⁰⁶ Eleni Ekmektsioglou, “AirSea Battle and Escalation,” *The Diplomat*, July 28, 2011.

¹⁰⁷ Jan Van Tol with Mark Gunzinger, Andrew Krepinevich and Jim Thomas, “AirSea Battle: A Point-of-Departure Operational Concept,” *Center for Strategic and Budgetary Assessments*, 2010.

¹⁰⁸ *Ibid.*

Many experts believe that future U.S. weapon systems must be able to fight through a precision strike network and not rely on the aforementioned sanctuaries of old.

Long-Range Strike System

Experts opine that adversary precision strike weapons such as ASBMs and ASCMs may drive the need for an advanced, stealthy, long-range precision strike system as a counter: “As the U.S. military focuses on fighting in a world where it can no longer count on unfettered access to the airspace over hostile territories, the Pentagon is looking at developing a new generation of precision weapons that can penetrate 21st-century air defenses and hit targets from thousands of miles away.”¹⁰⁹ “Long-range strike is the American javelin that can leapfrog A2/AD defenses and destroy targets on the ... mainland at minimal risk to U.S. forces.”¹¹⁰ The U.S. Air Force’s next-generation bomber is one such long-range strike program that proponents say can penetrate “no go” zones and destroy key enemy defenses opening the door for non-stealthy platforms which currently make up a majority of DOD’s arsenal.¹¹¹

The 2010 Quadrennial Defense Review (QDR) states:

Enhanced long-range strike capabilities are one means of countering growing threats to forward-deployed forces and bases and ensuring U.S. power projection capabilities. The Secretary of Defense has ordered a follow-on study to determine what combination of joint persistent surveillance, electronic warfare and precision-attack capabilities, including both penetrating platforms and stand-off weapons, will best support [U.S. power projection until 2040].¹¹²

These long-range strike systems are also intended to play a significant role in the new AirSea Battle concept. Air Force Vice Chief of Staff General Philip Breedlove stated, “Long-range strike is the heart of AirSea Battle. Whether that’s from a carrier, a bomber, a sub, a flying jammer, or all of them working together, the point is that the Navy and the Air Force have to come from anywhere in the world to overwhelm weapons systems that would otherwise keep the United States at bay. It allows us to penetrate from lightly contested to severely contested airspace and networks.”¹¹³

There has been high-level support for the next-generation bomber. When then Secretary of Defense Robert Gates addressed cadets at the United States Air Force Academy on March 4, 2011, he stated that “a new, optionally-manned, nuclear-capable, penetrating Air Force bomber ... remains a core element of this nation’s power projection capability.”¹¹⁴

¹⁰⁹ John Reed, “U.S. Targets Precision Arms for 21st-Century Wars,” *Defense News*, March 22, 2010.

¹¹⁰ Chas Morrison, “Long-Range Strike: The American Javelin,” *The Foundry: Conservative Policy News Blog from the Heritage Foundation*, posted August 12, 2011.

¹¹¹ For more information, see CRS Report RL34406, *Air Force Next-Generation Bomber: Background and Issues for Congress*, by Jeremiah Gertler.

¹¹² Quadrennial Defense Review Report, Robert M. Gates, Secretary of Defense, February 2010 p. 32.

¹¹³ Spencer Ackerman, “Budget Storm Could Sink U.S. Plan to Rule Sea and Sky,” *Danger Room (Wired.com)*, July 20, 2011.

¹¹⁴ Speech by Secretary of Defense Robert M. Gates to the United States Air Force Academy on March 4, 2011.

Additional proponents stated the new bomber is the Air Force's biggest new program and is "a must-have as anti-access/area denial threats improve and proliferate. Such threats are emerging even in what were once considered 'low end' conflicts, which means the service must buy weapons, like the bomber, that can be used across the spectrum of war."¹¹⁵ A new bomber would have the stealth capability to fly long distances, penetrate congested airspace and destroy adversary precision strike area denial weapons allowing for U.S. conventional forces to quickly follow.

Further, using China as an example, some argue that "given the dispersal of China's bases and its bomber fleet, the U.S. must develop a credible long-range strike bomber, in part as a way to ensure escalation control in any conflict with China. Relying solely on land- or sea-launched missiles for mainland strikes may prove to be destabilizing in a crisis, whereas stealthy manned bombers that can be recalled can serve to hold major targets at risk while preserving operational flexibility."¹¹⁶ The ability to strike targets worldwide is still an important deterrent for DOD.¹¹⁷

A criticism of the USAF long-range bomber program deals with the next-generation bomber in terms of manned vs. unmanned configuration as well as the complexity of the aircraft. The recall capability has been one argument proponents have used for keeping the bomber manned, while critics argue that neither a SLBM nor an ICBM is manned. Why, they ask, should the bomber be any different? In addition, it has been argued that the next-generation bomber should be programmed for the acquisition of hundreds at a lower cost vs. a few at an extremely expensive price, as was the case with the B-2. In an age of austerity and budget cuts, some say, these "exquisite systems" may no longer be viable.

A potential authorization and appropriation issue for Congress is whether to approve, reject, or modify the proposed long-range strike system such as the next-generation bomber.

Further Inquiry

This report focuses primarily on proliferating precision strike weapons systems and not the myriad issues associated with the ramifications of such proliferation or strategies to defend against them. The following is a short list of possible further questions for Congress to consider:

1. What are some asymmetric examples of combating the proliferation of precision strike? What are the benefits and risks associated with targeted technology proliferation to U.S. friends and allies? Should United States increase its building of allied/partner defense capabilities in countries near or surrounding aggressor state and non-state actors? If so, what type of equipment, capabilities and to what extent?
2. In areas that exploit precision strike capabilities to build sophisticated anti-access/area denial capabilities, does the United States have enough surface and sub-surface ships to economically cripple the aggressor state through a naval

¹¹⁵ Dave Majumdar, "Looming Cuts Worsen U.S. Air Force Dilemma," *Defense News*, August 15, 2011.

¹¹⁶ Michael Auslin, "The Growing Threat From China's Air Force," *Wall Street Journal*, August 24, 2011.

¹¹⁷ For more information on Prompt Global Strike, see CRS Report, *Conventional Prompt Global Strike and Long Range Ballistic Missiles: Background and Issues*, by Amy Woolf.

blockade? If not, what additional assets need to be acquired? What is the cost of these additional assets? What type of timeline is required?

3. What are the ramifications to current DOD overseas and forward-deployed basing considerations due to the proliferation of precision strike? During the build up to Operation Desert Storm, the United States had access to numerous key foreign bases with little threat from Iraq. Would that type of dynamic still be possible today? What about 10, 20, or 30 years into the future? If not, then what is DOD doing to mitigate these threats? Does the DOD need to readjust and develop a new strategy to conduct U.S. expeditionary warfare?
4. In regard to the developed and developing precision strike weapons possessed by China, how does that affect U.S. ability to support democratic Taiwan? What is the impact to the region if the United States appears inattentive to China's rapid military buildup? Conversely, what are the risks and implications to a bold and aggressive U.S. posture toward China? How does the United States maintain the freedom of movement, trade routes, and global commerce that are key to the United States and world economies, as well as to U.S. national security?

Author Contact Information

Randy Huiss
USAF Fellow
rhuiss@crs.loc.gov, 7-0432